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NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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Important I.C.I. Developments

Two announcements of more than usual interest, relating to Imperial Chemical Industries developments, were made this week. The first—which fully confirms a hint supplied by a CHEMICAL AGE correspondent a fortnight ago—is the open reference in the Chancery Court on Tuesday to a petition by I.C.I. for the revocation of three I.G. patents, understood to apply to dyestuffs, and a motion by the I.G. to amend the patents. The hearing of these matters is postponed until after the Long Vacation.

The second is the announcement relating to agreements which have been reached between the Chilean Finance Minister and I.C.I. and between I.C.I. and the I.G. Farbenindustrie A.-G. It may be recalled that Britain only began producing synthetic nitrogenous fertilisers after 1920, and there has been since then a phenomenal growth in production. In 1928 it exceeded a quarter of a million tons, a volume four times as much as in 1927 and eight times as much as in 1924. By the end of this year, when the additional units will be in operation at the Billingham works of Synthetic Ammonia and Nitrates, Ltd. (a subsidiary of I.C.I.),

the production will be on the basis of over three-quarters of a million tons per annum. This great increase in production capacity of I.C.I. has enabled the recent negotiations to be conducted on equal terms with the German synthetic industry, which commenced production in 1913, and with the Chilean nitrate producers, who have been established for a great many years.

There has been of late a great growth of consumption of nitrogenous fertilisers throughout the world, and still more so of the production of nitrogen fertilisers of different kinds. Recent work has greatly extended the range and variety of fertilisers. The great amounts spent by the large producers in research, experiments, and propaganda have caused some amount of overlapping. One effect of co-operation between the producers will be to provide farmers with the fertilisers best suited to their particular soils and crops, instead of the present striving after business without regard to the particular requirements of agriculture. Further, the increase in productive capacity was likely to lead to violent temporary fluctuations in price over periods.

The agreement just announced will enable the nitrogen producers of Germany, both synthetic and by-product, the British producers (I.C.I. of synthetic and the British Sulphate of Ammonia Federation on behalf of the by-products producers) and the Chilean Government, as representative of the Chilean nitrate industry, to co-ordinate and co-operate their experimental and research work and their propaganda. The basis has already been provided for a world arrangement, and the adhesion of the nitrogen producers of other countries is anticipated at some future date.

Colour Users' Problems

THE problems discussed in the annual report of the Colour Users' Association for the past year are much the same as those of recent years, that is, in the main, prices and supplies of colours. One issue of more specific interest, however, is drawing nearer as the Dyestuffs (Import Regulation) Act approaches the date of expiry—"ten years and no longer." The suggestion of the Chairman of the Association (Sir H. Sutcliffe Smith) that makers and users should confer together as to the best method of meeting the situation, and that the Development Committee should prepare a complete survey of the working of the Act, has been generally approved. The Development Committee is now at work on such a report and the Association has undertaken to furnish it with a statement of the colour users' views on various aspects of the industry. There is, therefore, some ground to hope that an agreed settlement may be arrived at among the interests immediately affected, which would be preferable on

every ground to a decision that followed this or that party's political policy.

Acknowledgment is made of the great services of the Association's representatives on the Licensing Committee, and close co-operation has resulted in the users' interests being considered and safeguarded in every way. Applications for licences have been expeditiously dealt with; approximately 7,500 have been dealt with by the honorary technical adviser. The Association records its satisfaction at the reduction of the price factor to $1\frac{3}{4}$ times pre-war price as the result of negotiations.

Among the matters considered by the Council has been the question of the introduction by British manufacturers of equivalents of certain German products, with the result that users who were quite satisfied with German colours found themselves compelled to buy the British equivalents at considerably higher prices, owing to the fact that while the British manufacturers need not sell at less than twice the pre-war price, the German prices were often considerably lower than that. The suggestion put before the Licensing Committee was that the British manufacturers should, in the case of counter products to those imported, accept the same price as the foreign manufacturers had been selling at during the previous three months, and the users would then agree to stabilise that price for the following six months.

Another point that has engaged the attention of the Council in connection with licensing procedure is the suggestion of the makers' representatives that in dealing with applications on price grounds the British manufacturer should be entitled to make an addition to the pre-war price if, in his opinion, the quality of the product offered was superior to that manufactured pre-war. The Council took the view that this involved a breach of the principles which have been in operation since the introduction of the factor method for dealing with licences on price grounds, and the Association's representatives are maintaining this point of view. Attention is also drawn to the change made by the Government authorities in the procedure regulating the importation of dyestuffs samples. Hitherto it has been possible to obtain small samples of foreign dyestuffs by letter or sample post without undue delay, but the authorities have now ruled that this procedure is irregular and that in future samples of foreign dyestuffs can only be imported by parcel post, which the Association regards as a "much more expensive and cumbersome method." Some concessions have been obtained, but the Council continues to press the matter with a view to a scheme being agreed upon that will satisfy both the users and the Government departments concerned.

The dyestuffs situation abroad is still engaging attention, and considerable work has been done in obtaining and considering data and statistics of dyestuffs production, prices, exports and imports, etc., in various countries. Group buying of indigo continued until June 30, 1928, and substantial rebates were obtained by members. For the period ending June 30, 1929, indigo has been reduced considerably in price as a result of further negotiations and no rebates are now applicable.

The Chemical Traders' Standpoint

THE speeches at the annual meeting on Wednesday of the British Chemical and Dyestuff Traders emphasised, as they would naturally do, the importance of open markets, unhedged by protective tariffs and uncontrolled by combines and cartels. From this point of view the craft of merchanting has, of late, been considerably harassed, for even in a traditionally Free Trade country like this, Safeguarding duties and Dyestuff Licensing Acts are openly in operation, and in this country, too, has been organised, in a remarkably short period, the greatest chemical trust in the world. There is, on the part of the merchant class, no open protest against Safeguarding where it is necessary for national safety; but there is a very strong protest against extending Safeguarding into full-blown Protection, and surrounding it with what the merchant denounces as irksome regulations. Nor is there any proposal that trusts should be prohibited; what is hinted quite plainly is that, as the result of price agreements, allocations of markets, etc., the consumer may suffer, and the merchant may be pushed out of business altogether.

In the speeches of Mr. A. F. Butler (the chairman) and Mr. Victor Blagden (the president) the difficulties of the situation were fully explained, and the need of taking measures to protect the merchant interest emphasised. It is, of course, inevitable that the manufacturer's standpoint should be different from that of the merchant; at the same time there will be a certain sympathy with Mr. Blagden's challenge on the subject of British salesmanship. No country, he declared, has a better sales organisation than Great Britain with its old-established merchants, the "intelligence officers of industry" having ramifications in all parts of the globe. What is needed, he claimed, is more support for them. That is just where the manufacturing interest clashes. For the modern policy of the producing class—especially the large-scale organisations—is to take on their own merchanting work, and, in doing so, they pay the merchants the convincing compliment of imitation.

Books Received

- THE REACTIVITY OF COKE. Fuel Research Technical Paper No. 22. London: H.M. Stationery Office. Pp. 30. 1s.
- EINFÜHRUNG IN DIE THEORETISCHE WIRTSCHAFTSCHEMIE. By Dr. Phil. Rudolf Koetschau. Dresden and Leipzig: Theodor Steinkopff. Pp. 152. 13.50 R.M.
- F.B.I. REGISTER OF BRITISH MANUFACTURERS. 1929-30. London: Federation of British Industries. Pp. 670.
- ARTIFICIAL SILK (RAYON), ITS MANUFACTURE AND USES. By Thomas Woodhouse. London: Sir Isaac Pitman and Sons, Ltd. Pp. 246. 7s. 6d.

The Calendar

July		
1	Royal Institution: General Meeting. 5 o.m.	21, Albermarle Street, London.
5	Colour Users' Association: Annual General Meeting. 12 noon.	Blackfriars House Assembly Room, Manchester.
16	Society of Chemical Industry (South Wales Section): Visit to works of J. S. Fry and Sons, Ltd., Somer- dale, near Bristol.	Bristol.

New I.C.I. Agricultural Research Station

At Jealott's Hill, near Maidenhead, formally opened on Friday, June 28, by the Rt. Hon. J. H. Thomas, M.P.



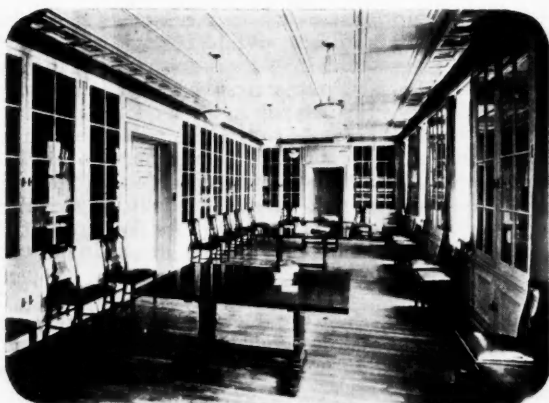
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THE NEW SHIPPON.

The Handling and Packing of Chemicals

By Rex Furness

For some considerable time past the chemical trade of this country has been improving, and exports have been steadily increasing. The home trade, too, in spite of an unfortunate condition of stalemate in some directions, mainly due to the depression in the textile industries, supplies a vast amount of chemicals for innumerable purposes. Important as are new discoveries, improved processes and general schemes of rationalisation, the questions of handling and packing demand attention, for considerable economies may result from the adoption of up-to-date methods.

THE mechanical handling of chemicals, raw materials and finished products has been brought to a fine art, and the makers of elevators, conveyors, pumps and the like are able to offer a wide range of devices by means of which much labour can be saved and the general handling of materials carried out more expeditiously than by the methods of hand labour.

As the subject has been carefully discussed in many past issues of THE CHEMICAL AGE it is proposed in this article merely to give brief illustrations of the variety of processes to which mechanical handling can be applied, and to deal more fully with packing and packages.

Different Solutions for Different Problems

It must not be assumed, however, that every handling problem can be solved most economically by the installation of mechanical handling equipment—as is sometimes suggested—but at the same time it is a comparatively simple matter to weigh up the position upon an economic basis and to pass judgment accordingly. Local conditions may make all the difference, as is instanced by a case with which the writer has recently been in touch. Two plants making the same product by exactly the same process were so circumstanced that it proved advantageous to instal band conveyors in the one but not in the other.

Expert advice is offered by the makers of mechanical handling plant, and definite quotations for any equipment are made. The owner of a chemical plant, knowing the precise cost of handling by existing methods, is then in a position to review the whole matter and come to a proper decision. This all seems only too obvious, but experience has shown that the main point is sometimes lost sight of in an intense eagerness to be "modern" in outlook and action.

A Few Instances

Let us cite a few instances where mechanical handling plant may be expected to prove economically successful:

- (1) The discharge of coal from wagons and its passage to storage, thence to the mechanical stoker of the boiler installation or the mill of the powdered coal firing equipment. Here, too, may be mentioned the various devices for ash removal, sorting and discharge outside the plant.
- (2) The handling of liquids, including acids, by means of pumps of various kinds, blowing eggs and so forth, coupled with gravity feed to particular points whenever possible.
- (3) The pneumatic handling of powdered or other raw materials or finished products, as in the discharging of oil seeds and nuts, soda ash, salt and so forth, and in the passage of cement to storage bins and its packing into bags or other suitable packages.
- (4) The conveyance of materials made in large bulk to cutting, powdering or like devices, and the subsequent packing and wrapping of the suitably divided material by mechanical means, entirely or partially.
- (5) The transfer of hot material from a furnace either to storage or to a subsequent process by means of specially designed band conveyors. A good illustration of this less commonly practised form of mechanical handling is the transfer of "soluble glass" from the silicate furnace to the dissolvers where standard solutions of silicate of soda are made.
- (6) Similarly, there are available conveyors for powdered,

plastic or viscous materials, as well as for corrosive and dangerous chemicals.

(7) Mention may be made, too, of the various means of transporting materials within the works, such as motor trucks, telfers, overhead transport systems, cranes, grab buckets, mechanical shovels, barrel-handling devices, carboy trucks and handling devices, etc.

Both in the choice of materials of construction and in the design of equipment, our makers of mechanical handling installations have caught up with their foreign competitors, and are able to offer a solution for almost every handling problem. The advisability of accepting the offer is readily determined by the chemical engineer, the technical chemist or the works manager on the spot, after all circumstances have been duly considered.

Packages

The cost of packing and packages is by no means inconsiderable, particularly in the case of bulky materials of relatively low value, such as heavy chemicals in general. When containers are non-returnable, it is of great importance that cheapness receive careful consideration, but no sacrifice of quality of the packed chemicals can be allowed. It is a duty of the chemist to survey the many types of barrels, drums, bags, paper containers, etc., which are available, and to choose containers suited to the particular chemical in question.

The transport of strong acids has always been a problem, and it has always been realised that carboys provided a most unsatisfactory mode of working from many points of view. To-day, much more suitable means of carrying acids are at hand, and reference need only be made to the conveyance of hydrochloric acid in tank cars, lined with hard rubber, or (for smaller quantities) in rubber-lined barrels, to the use of aluminium vessels for strong nitric acid, or to cars constructed in nickel-chrome steel alloys (non-corroding steels) for various strengths of the acid and for other corrosive chemicals.

Tank Cars

The value of tank cars has become more apparent in recent years, and in some instances it has been found profitable to ship caustic soda in the form of a concentrated solution in tank cars. Whilst it would appear that in this case transport charges are being paid upon water which is readily and cheaply removed within the works producing the caustic soda, it has been found in many cases that the employment of tank cars makes this water-carrying charge even less than the saving achieved by the avoidance of the final stage of evaporation in "caustic pots" necessary when solid caustic soda is to be marketed. In addition, it is often more convenient for the user to have standard solutions immediately available without the trouble of dissolving solid soda, not too pleasant an operation even when flake caustic soda is purchased.

Tank cars of all sizes suitable for the conveyance of corrosive, oily or volatile products, by road or rail, are now available, and their use should receive every consideration.

Before passing to a description of the various types of drums and barrels, employed when smaller amounts of chemicals are to be shipped, a word or two may be said

as to the many machines which are now made for the automatic packing, wrapping, weighing, sealing, etc., of materials which are ordinarily sent out in fairly small packages. It is well known that machines of amazing ingenuity are now made whereby the division of bulk material into smaller exact amounts, the wrapping, packeting or cartoning and sealing, and even the final boxing are effectively carried out almost without a touch of the human hand upon the material. Similarly, the automatic filling, capping and labelling of bottles is readily accomplished by modern equipment.

In the case of materials such as soaps, tea, sweetmeats, cooking fats, etc., which are marketed in small quantities, and millions of packages of which are required by the public daily, the use of mechanical packing devices is essential for over-all economy and speed. On the other hand, in the case of fine chemicals and medicinals, it is of great importance that suitability of packing be the main consideration. Many materials have a small but definite action upon certain glasses, so that deterioration of the packed goods may readily occur. The highest class perfumes must be packed in specially selected glass bottles, for the alkali liberated from ordinary glass bottles may be found to be destructive of the fine odour and to cause discoloration or dulling of the perfume. Cases have been known where lead has been taken up by a medicinal chemical from an unsuitable bottle.

The British glass industry is able to provide bottles made from glasses which are absolutely unattacked by fine chemicals, so that the risk of deterioration can be entirely avoided.

Drums

Heavy chemicals are frequently transported in various types of drums, and, once again, the chemist can save much money by selecting a drum which, while cheap, is yet perfectly suited to the material it is to contain.

The plain steel drum is, perhaps, the cheapest container of this class, and should be used whenever possible. Provided the chemical has no action upon the steel, this drum may be relied upon to give satisfaction to the buyer as well as to the seller. Caustic soda and silicate of soda may be cited as examples of chemicals which are shipped in such drums, whilst it is clear that galvanised drums (besides being dearer) are quite out of the question by reason of the action of the alkali upon the coating. On the other hand, galvanised drums are preferably employed for the transport of glycerine, oils, and aqueous liquors, which would become contaminated by rust if shipped in plain steel drums.

For packing high-grade heavy chemicals such as pure or "C.P." glycerine, drums lined with pure tin are available, and, while more costly, are essential in many instances.

A very convenient form of drum is that fitted with a detachable head which is ordinarily held in place by a series of studs fitting the head to an angle iron with the aid of a suitable packing material. Such drums have been found useful for the transport of fats, solid caustic soda, etc., where convenience of discharge is an important point. Their use for the transport of liquids may, in some instances, be found feasible, but careful attention must be given to the packing of the joint.

Special Cases

If it be desired to pack deliquescent materials, or materials holding water physically, in drums, the latter may be obtained conveniently coated with a film of paraffin or a synthetic resin composition. In the latter instance, acidic or alkaline materials may often be found to be prevented from gaining access to the steel of the drum, so that staining of the product with iron rust may be completely avoided. Some water-softening zeolites are sent out containing water physically absorbed in their structure. It is important that this water be not lost by evaporation. Barrels,

ordinary packages and drums have been found impracticable by reason of the evaporation of water in the case of barrel shipment, and iron staining in the case of shipment in steel drums. Paraffin-coated drums have been found very suitable, for the coating is firmly held by the surface of the drum after discharge, whilst the product is as pure and "wet" after long standing in the drum as when first packed.

Smaller quantities of chemicals are often sent out in lead-coated sheet-iron or tinned iron boxes, and "tins." The latter are somewhat more expensive, but are sometimes to be preferred. The seams may be soldered or varnished when required, for certain chemicals "creep" through a seam which appears to be so tight as to need no "filling." Thus a "tin" which will hold water will often allow chemicals to creep through its unsoldered or unvarnished seams.

Many chemicals may be satisfactorily transported in boxes, tubes or containers of various shapes and sizes made from built-up paper board or corrugated board. Such containers are made in various strengths, and are often lined with paper facings. The cheapness, lightness, strength and general attractiveness of this type of container has made it very popular, and manufacturers present for its construction remarkable materials which stand up to the transport of many chemicals without loss of, or damage to, the material packed.

Barrels

The usefulness of barrels needs no emphasis, but they must be suited to the chemical they are to carry. Thus caustic soda, being avid for water, will take it up even through a "tight" barrel, expanding and often bursting the container.

Barrels usually employed for the shipment of chemicals comprise at least three classes, namely, slack, semi-tight and tight. Slack barrels are well suited to the conveyance of chemicals which are not efflorescent, and are built in sizes to carry from 50 to 500 lb. Amongst the products which may be carried in slack barrels with safety are ammonium picrate, asphalt, cement, dry chemicals, lime, arsenates, paint and pigments, picric acid, etc.

A second class of barrel consists of tongued and grooved barrels. To provide a practical, efficient and economical container which will adequately fill the requirements of the chemical industry for the shipment of efflorescent and semi-liquid products, the slack cooperage industry has evolved what is known as the tongued and grooved slack barrel. This barrel is made from staves one-half inch thick, the heads being made of thicker wood (say, five-eighths inch) in many cases. The staves are tongued and grooved and the heads glued. Thus a practical water- and air-tight package is provided.

The significance of the "tight" barrel is obvious, and such barrels may be employed for the transport of liquid and semi-liquid materials. With suitable lining, say with glue, silicate of soda or paraffin, such barrels may be found suitable for the conveyance of some acids and alkaline chemicals, while non-corrosive liquids may be shipped without fear in most instances. It is clear that the barrel maker must examine carefully the construction and materials used in order that efficient service may be rendered, but, after a series of long-continued experiments, it has been found possible to assure the shipper of chemicals a safe passage for his product in tight barrels.

It is not proposed to enter deeply into the question of specifications for barrels of any of the classes briefly described above, but it may be said that the cooperage industry has made successful efforts to retain customers and win new ones in the face of keen competition at the hands of drum makers and built-up-board makers. In many cases, the barrel is still, perhaps, the most suitable container for chemicals.

To those who use barrels in large numbers much useful information has been afforded in chemical literature as to the best methods of stacking, storing and inspecting the barrel stock.

It has been indicated above that tight barrels are frequently lined with glue, paraffin or silicate of soda. Not one of these materials can claim universal usage or all the advantages, and all find a large field of utility. As the use of silicate of soda represents the cheapest way of lining barrels, it is proposed to devote a little attention to this matter, indicating where the extra use of glue or paraffin is usually advantageous. In those cases where it has been assumed by the barrel maker, or the user of second-hand barrels, that glue or paraffin is absolutely essential, it will frequently be found that a first coating with silicate of soda will effect great saving in lining costs, and will give a barrel which will stand up to all requirements.

Barrel Lining

It should be pointed out that the name "silicate of soda" covers a wide variety of products which have been carefully standardised in respect of their alkali-silica ratio, viscosity, setting time, etc., so that the most suitable silicate of soda may be chosen for a specific use. Thus, special varieties are available for the purpose of barrel lining which afford readily-absorbed liquors, drying out quickly to a glassy, impervious coating which adheres tenaciously to the surface of the barrel. If, here and there, after long or rough usage, a small portion of the coating becomes dislodged, it is soft and harmless, and in the case, say, of mineral lubricating oils packed in silicate-lined barrels, a rare instance of lining dislodgment is of no consequence as regards the use of the oil.

The use of a proper silicate of soda in the cooperage industry falls into three classes, namely: (1) When barrels are manufactured, silicate can most conveniently be used for the first or "test" coat; (2) when barrels are being prepared for filling, a lining coat of silicate may advantageously be given; and (3) when second-hand barrels are to be used they should be given a preliminary cleansing with hot alkali solution and then lined with silicate of soda solution.

It is found economical to use silicate for the test coat, even when it is thought best to give a second coat or lining of glue or paraffin. Moreover, glue over silicate is better than glue over glue.

Returning to the use of silicate as a test coat, its advantage lies not only in its cheapness, but also in the fact that very hot solutions may be used (which solutions do not ferment nor putrefy nor change their composition). A higher temperature causes the development of a greater pressure in the barrel, and helps to reveal all the "worm holes" and other sources of possible leakage.

The Use of Silicate

The method of using silicate is simple. When used for the test coat upon barrels made of elm, white oak or chestnut oak and similar woods, barrel-lining silicate can conveniently be diluted with three or four times its volume of water. In the case of more porous woods, the silicate should be diluted with less water, say, twice its volume. In every case, the silicate liquor should be used as hot as possible, up to almost 100°C. Two to five gallons of the diluted silicate should be poured into the barrel (previously cleaned with alkali solution if necessary) and the bung tightly inserted. After vigorous rolling for a few minutes the unabsorbed silicate liquor should be run back to its tank and the barrel drained. The pressure developed within the barrel will be found to drive some of the liquor into the wood and to show up the places which need attention by the appearance of liquor on the outside surface of the barrel. It will be found that only about half a pound of silicate is actually consumed in this process of test-coating and first lining.

When glue or paraffin is to be used for the second coat, the procedure does not depart from the normal. When silicate is to be used for the final lining, slightly stronger solutions than are employed for the test coat are used, but otherwise the operations are the same as noted above. A consumption of about two pounds of silicate per barrel is usual, and a fine, glassy, adherent coat is provided.

There are many users of silicate who have erected runways and the like arrangements for facilitating the operations of coating, emptying, draining and drying, but space prevents a description of these labour-saving devices.

Silicate-lined barrels are largely used for carrying animal and vegetable oils, fats and greases (cotton-seed oil, linseed oil, lard and lard oil, soapmakers' fats and the oils and greases from packing and rendering plants), mineral oils of various gravities, etc. If the silicate coat is thoroughly dry before the glyceridic material is packed, there need be no fear of the alkali of the silicate effecting saponification of the oil or fat.

Thick mineral oil products are largely shipped in silicate-lined barrels, but experience varies with thinner products, while turpentine is perhaps best shipped in barrels given a glue lining over silicate. Strong alcohol is held satisfactorily in silicate-lined barrels, but aqueous alcohol has a dissolving action upon the lining. For the same reason, thick fruit syrups may be shipped in silicated barrels, but not thin aqueous syrups.

Silicate of soda offers to-day the most promising opportunity for effecting economies in barrel service.

Patent Action Between I.C.I. and I.G.

Hearing after Long Vacation

ON Tuesday, in the Chancery Division, a pending petition by Imperial Chemical Industries, Ltd., for the revocation of three letters patent relating to dyes belonging to the I.G. Farbenindustrie A.-G., and a motion by the respondents to amend their patents, was mentioned to Mr. Justice Romer, on an application by the German company to postpone till after the Long Vacation the trial which had been fixed for July 1.

Mr. Trevor Watson in making the application said that Dr. Oberlander and Professor Goldsmith, their experts, were in Germany, and it was impossible for them to finish their experiments by July 1.

Mr. Stafford Cripps, K.C., for Imperial Chemical Industries said that there were nine million possible experiments that could be made with these dyes, and the respondents could come after the Long Vacation and say that they had only conducted ten thousand of them. It would make an enormous difference to his clients' business if they were prevented from making these dyes for three months, and possibly longer.

His lordship said that if, in first instance, Imperial Chemical Industries had given the German group full particulars of their objections to the patents, the experiments might have possibly been ready by July 1. Under the circumstances he postponed the trial until after the Long Vacation.

It was mentioned that the trial will take at least three weeks.

Methylated Spirits Regulations

A COMMITTEE appointed by the Commissioners of Customs and Excise, consisting of members of H.M. Customs and Excise, and of the Government Laboratory, has been appointed to revise the Statutory Regulations dealing with methylated spirits, including the Power Methylated Spirits Regulations, 1921 (Statutory Rules and Orders, 1921, No. 1318), and the Methylated Spirits (other than Power Methylated Spirits) Regulations, 1925 (Statutory Rules and Orders, 1925, No. 1240). The committee has forwarded a preliminary draft of the new Regulations to the council of the Institute of Chemistry inviting observations and suggestions thereon; also inviting the council to nominate one or two representatives to support, if necessary, the views of the council at a subsequent discussion with the Committee. The document is a lengthy one, and does not embody any very drastic change, but it will certainly be advantageous to have the regulations in a more comprehensive form for reference. The council has referred the matter to a special committee with power to act.

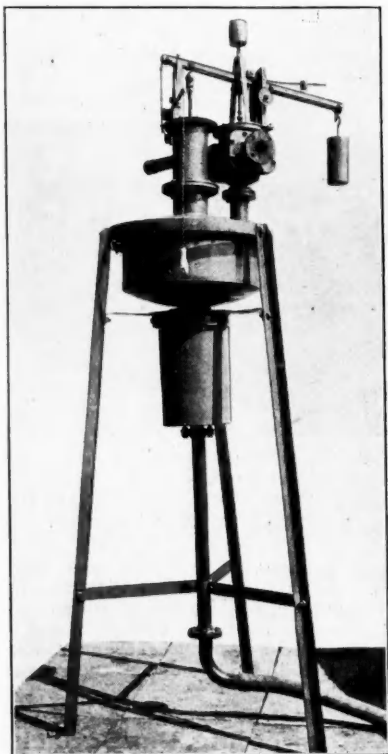
Modern Methods of Packing and Storing

An Account of Some British Products

The great importance of methods of packing, etc., in the chemical industry should lend special interest to the following account of some of the British products which are available for the purpose.

Acid-Resisting Tanks, etc.

THE Nordac rubber concrete acid storage tank, manufactured by Nordac, Ltd., of Reno Works, Wealdstone, Middlesex, is gaining favour. The company has also recently put on the market an automatic acid meter (shown herewith) which enables definite quantities of acid to be withdrawn from a tank automatically. The rubber-lined pipes and valves manufactured by the company are meeting with increased



AUTOMATIC ACID METER.

favour, and the company have built up a business as suppliers of properly engineered rubber plant for chemical operations. Their work is completely engineered from start to finish, and fitted with pipes, floats, electric tell-tales, valves, meters, etc., so that the chemical manufacturer is relieved from much expensive control and nuisance.

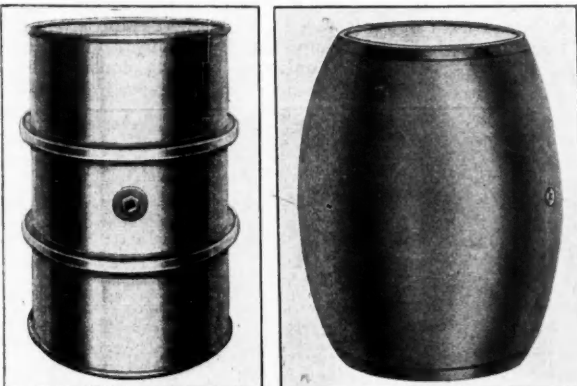
Increased business is also being done in lining plant for the precipitation of iron oxide from spent liquor; galvanising tanks where rough usage has to be met; colour manufacturers' vats, and the repair of leaking and damaged tanks.

New and Secondhand Drums and Barrels

THE trade are probably not aware of the fact that Victor Blagden and Co., Ltd., of 4, Lloyd's Avenue, London, E.C.3, have, for many years past, made a practice of holding a large stock of new and secondhand steel drums and barrels of the usual standard sizes and grades, which enables exporters and other firms interested to obtain delivery at a moment's notice. This has undoubtedly been of considerable service to the trade, for, so often, an order is lost owing to the inability to obtain suitable containers on the spot. This firm has issued a most attractive catalogue which not only gives valuable information regarding the specification of their drums, but also contains

full details of the standard B.G. gauge used in connection with the manufacture of packages. Catalogue will be sent to any interested firms in the trade, upon application.

In addition to their stock of new drums, they handle at their main depots, which are fully equipped with the most up-to-date plant for repairing, cleaning, etc., secondhand

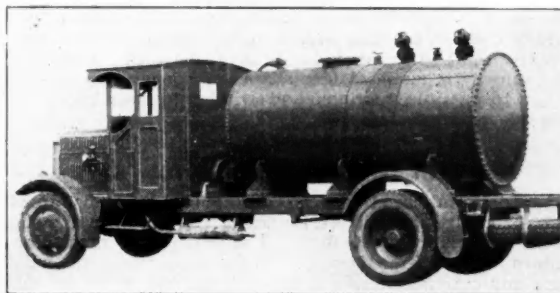


V.B. STEEL DRUM, TYPE B. V.B. STEEL BARREL, TYPE A.

drums of various standard sizes, and almost unlimited quantities can be delivered at a moment's notice. Firms interested in industrial spirits and various solvents will be interested to learn that recently Victor Blagden and Co. have placed on the market a specially prepared galvanised package which obviates many of the troubles experienced in the past. The steel sheets are prepared and galvanised by a special process which avoids contamination and assures satisfactory delivery of a waterwhite product, without the milky appearance which so often occurs when conveyed in the ordinary standard galvanised drum.

Welded Steel Casks, Barrels, etc.

THE Steel Barrel Co., Ltd., of Uxbridge, Middlesex, are manufacturers of electric arc-welded steel barrels, casks, and drums. Their type B barrel may be obtained in capacities from 10 to 200 gallons, and is claimed to combine extreme strength and durability with ease of handling and low rail charges. Their



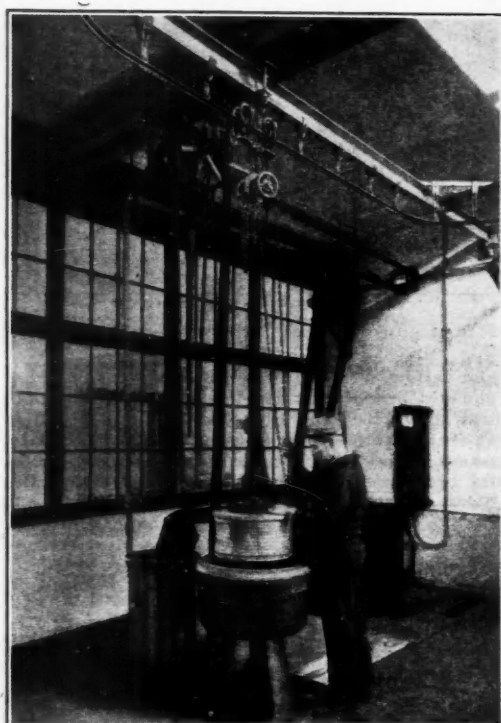
A TANK ON A LEYLAND Q.H.2 CHASSIS.

type R drum has pressed-out rolling hoops externally strengthened with heavy mild steel strips shrunk on to the body (capacity 5 to 150 gallons), and complies with the railway companies' specifications for the conveyance of inflammable liquids; while the type Q drum (same capacities) has rolling hoops made of strong section H bars, and chimbs strengthened

with inner and outer steel strip to withstand the hardest usage. The type QC drum (capacity 20 to 150 gallons) has pressed-out corrugated rolling hoops. All the above may also be supplied in the galvanised form. The type C and type X drums are supplied to meet the need for light, non-returnable drums. Other products manufactured by the company include barrels for strong sulphuric acid; drums with removable ends (suitable for vegetable oils, etc.); welded or riveted steel storage tanks (capacity 250 to 12,000 gallons); welded steel tanks for special purposes; welded steel road and railway wagon tanks; riveted or welded air receivers, etc.

Runways

RUNWAYS made up of a few standard parts, and very easily constructed, are manufactured by Herbert Morris, Ltd., of Loughborough. They are supported by "hangers" from any kind of support found in ordinary building construction,



A RUNWAY BRINGING A LOAD TO A CENTRIFUGAL DRIER.

and track is supplied in 14-ft. lengths. The standard parts may be coupled together in an endless variety of ways, giving exactly what is wanted to fit any particular conditions. The runway is moulded into shape on the job, curves being put in to pass obstructions, and switches to run a branch into other departments.

Sheet Metal Containers

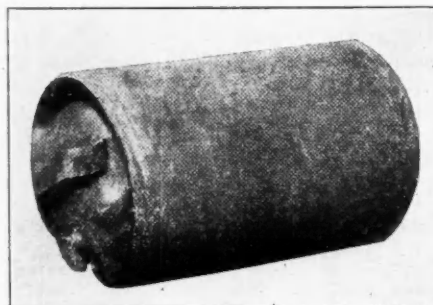
As an old-established concern, dating back to 1869, Reads, Ltd., of Bridgewater Street, Liverpool, have been in the sheet metal business from this date. The progress of metal manufacture has been transformed. In the earlier days the handwork and craftsmanship was an essential feature of the sheet metal working industry. They were then engaged on varieties of this class of work, mainly for shipping. The whole industry has passed through various stages of evolution, and from small beginnings the company is now one of the largest sheet metal working firms in the whole country.

The chemical industry has gained by the accumulated knowledge that Reads have been able to give them in the designing and production of every class of sheet metal package that has been required by the trade. In producing these packages

they have had to contend with many difficulties. They have been able to produce and deliver to the chemical industry packages that would carry its commodities and deliver the contents in good condition thousands of miles away from this country. Considering the difficulties of transit and transport and the number of handlings that must necessarily take place, the chemical industry is indebted to the tin box and iron drum makers for the packages that have been produced for it. Reads, Ltd., are capable of turning out tins from half an ounce in capacity up to sheet drums to hold 4 cwt. Shapes of every conceivable kind are supplied. The main thing to be appreciated in the production of sheet metal packages is strength compatible with the lightness of material, and perfect design and manufacture.

Patent Bevel-Edged Drums and Kegs

THE strength of a metal container is one of its chief claims to recognition, and in this respect special claims are made for the patent bevel-edged drums and kegs manufactured by E. A. Brough and Co., of 4, Upper Parliament Street, Liverpool. For example, a 7-8 lb. drum of this type can be dropped



A BEVEL-EDGED WELDED DRUM, ABSOLUTELY SOUND AFTER BEING DROPPED WHILE FULL FOR A DISTANCE OF 51 FT. THIS, A STOCK DRUM, SUBSEQUENTLY WITHSTOOD TWO FURTHER FALLS OF 51 FT.

24 ft. without bursting, while others have withstood still severer tests. The makers point out that the drums (which have welded seams) are, in addition to their enormous strength, of neat and pleasing appearance, dust-proof and water-proof and (in virtue of a special corner neck) are emptiable to the last drop. A photograph illustrative of the strength of the drums is shown herewith.

Waterproofing Paper Sacks

A new method of waterproofing paper sacks and other articles has lately been evolved by Impervious Packages, Ltd., of Duxford, Cambs. The paper sacks are impregnated with waterproofing material and dried on a conveyor by a new continuous process. These waterproof paper sacks, while primarily intended to meet the demands of the Portland cement trade, have found many other uses, and lend themselves, in various strengths and sizes, to the protection of China Clay and many other chemicals and products which are by nature hygroscopic or liable to damage by moisture and rain. Independent tests of these waterproof paper sacks, filled with Portland cement, have been made over periods of six months' exposure in the open, the cement being quite unaffected by any weather conditions. Besides cement, hydrated lime, etc., these sacks are particularly suitable for basic slag, nitrates and other fertilisers, and the farmer is thus able to dump them out in the fields, pending an opportunity for spreading, without fear of loss. While, naturally, the waterproof paper sack costs slightly more than the ordinary paper sack, it must be remembered that the extra durability and the adequate protection of goods, both in transit and store, will obviate vexatious claims for damage, besides being greatly appreciated by the customer.

Impervious Packages, Ltd., are in a position to waterproof customers' own paper sacks or to supply waterproof paper sacks of any required size and strength.

Steel Containers

STEEL containers of numerous types are manufactured by G. T. Johnson and Co., of 63, Great George Street, Liverpool. Their products include the following:—Steel kegs, open top with full loose lid (for paints, colours, grease and other pastes and powders); steel drums, with centre filling hole and lever lid (for grease, soft soap, and various paint and powder goods); steel drums with soldered joints (for oil, mixed paint, disinfectant, and all liquid goods); steel drums with welded joints (suitable for practically all liquid goods); and steel taper cans with soldered joints (for turpentine, white spirit, varnish, etc.). These are made of plain black steel or lead-coated steel, with hooped, double seamed, welded or riveted bottoms, and with plain or corrugated bodies.

Storage of Gases

IN view of the increased use of gases in the chemical and allied industries, their storage, often in highly-compressed form, becomes an urgent problem. The Chesterfield Tube Co., Ltd., of Chesterfield, manufactures drawn steel cylinders for the storage of oxygen, hydrogen, nitrogen, coal gas, methane, sulphur dioxide, carbon dioxide, nitrous oxide, ammonia, chlorine, phosgene, acetylene, etc.

U.S. Credit for Ruhr Chemicals Corporation

£600,000 Deal

A \$3,000,000 (£600,000) six-year credit at 8 per cent. for the Ruhr Chemicals Corporation was arranged on Tuesday by Dillon Read and Co., of New York, in association with a German banking group consisting of the A. Schaaffhausenscher Bankverein, the Deutsche Bank, Simon Hirschland and Messrs. A. Levy. The Ruhr Chemicals Corporation is one of the two outstanding examples of industrial rationalisation in the coal, iron and steel companies of the Ruhr district. The other is the Ruhr Gas Corporation, also financed by Dillon Read and Co. This concern is spreading a network of gas pipe lines through Western Germany, utilising the surplus coke-oven gas of the Ruhr heavy industry. The same raw material, coke-oven gas, formerly wasted, is the basis of the development of Ruhr Chemicals, which uses the gas for nitrogen products, chiefly fertilisers. The Ruhr Chemicals Corporation has just put into operation a plant combining the Concordia-Linde process for obtaining nitrogen and hydrogen from coke-oven gas, and the Casale process for converting these into synthetic ammonia. The construction of the plant was financed by Dillon Read and Co. with a loan of \$4,000,000 (£800,000). The new credit will extend the plant to more than double its present capacity. Next year its production is expected to reach an annual capacity of 500,000 metric tons of nitrogen products.

Oil Hydrogenation Plant

New Development by Standard Oil Co.

THE first-fruits of the formation of the American I.G. combine, in which Fords and the Standard Oil of New Jersey participated, are the erection of a commercial plant in New Jersey by the Standard Oil Co. for the hydrogenation of petroleum. The construction of the plant involves a plan to produce 100,000 barrels of petrol daily, and the decision followed two years' experimentation with a small plant in Louisiana, where it was found that 100 per cent. of petrol could be recovered from crude oil, as compared with between 35 and 45 per cent. by the most modern cracking process now used in the United States. Cracking is much less expensive than hydrogenation, but it is considered that the building of the new plant indicates that the New Jersey Corporation regards the costlier process as more economical. Students of the oil industry believe that hydrogenation will come into general use in conserving the world's oil supplies, and ultimately will supplant all the widely-used methods of oil refining. This prediction is based partly on the fact that the disposal of the excess of heavy oils has been a tremendous problem for the oil industry, and its sale at a low price for heating and power-making purposes is one of the principal reasons for the depression in the coal industry.

The Reactivity of Coke

An Examination of Metallurgical Cokes

THE Fuel Research Technical Papers, published by the Department of Scientific and Industrial Research, form a series of special papers and reports on the results of work carried out at H.M. Fuel Research Station or elsewhere. Paper No. 18 of this series entitled "The Reactivity of Coke. 1—Standardised Method for the Determination of Comparative Values," described a method of comparing the reactivity of cokes as measured by the amount of carbon dioxide reduced when the gas is passed over heated coke under standardised conditions. The numerical values obtained are comparable among themselves, but refer only to the precise conditions which have been standardised in the apparatus used. In a paper just issued, "The Reactivity of Coke. 2—The Examination of a Number of Metallurgical Cokes," by J. H. Jones, J. G. King, and F. S. Sinnatt (H.M. Stationery Office, pp. 30, 18.), it has been possible to show that a broad correlation exists between the behaviour of the coke in the "reactivity" apparatus and its physical strength as indicated by the shatter test. Indications are also given as to the effect of the conditions under which the coal has been carbonised and of certain inorganic constituents. The investigation is being carried out in co-operation with the National Federation of Iron and Steel Manufacturers, who are contributing to the cost. Other aspects of the general problem are being investigated by the coke research committees working under the auspices of the Federation.

Detection of Mustard Gas

International Competition Sponsored by Red Cross

THE International Committee of the Red Cross (the address of which is 1, Promenade du Pin, Geneva, Switzerland) has opened an international competition for the production of a reagent for the detection of dichloroethyl sulphide (mustard gas, Yperite). The reagent must be capable of detecting 0.07 milligrams of mustard gas in 1 litre of air; it, and the apparatus connected with it, must be easily produced and not too expensive. Ten thousand Swiss francs have been set aside for the competition, to be awarded as a whole or divided. The competition begins on July 1, 1929, and closes on December 31, 1930. Chemists who desire to compete must send their entries to the Secretariat of the International Red Cross, Geneva, before December 31, 1930, in the following manner: (a) Name and address of the competitor in a sealed envelope; the envelope must bear a motto, and a statement that the reagent is the result of personal work; (b) in a separate envelope, on which the motto is repeated, the detailed method of detection of mustard gas. The permitted languages are French, English, German and Italian. On January 31, 1931, the International Committee will open the envelopes containing details of the methods, which will be translated into French for purposes of adjudication. The successful reagent or method will bear the name of the discoverer, and will be the property of the International Red Cross.

Patents Committee Begins Work

THE Patents Committee under the chairmanship of the Right Hon. Sir Charles Sargant have begun their investigations, and persons and associations who wish to submit suggestions or to give evidence before the committee are invited to communicate with the secretary, Mr. R. W. Luce, Industrial Property Department, Board of Trade, 25, Southampton Buildings, London, W.C.2. The committee were appointed by the Board of Trade to report whether any amendments in the Patents and Designs Acts, or changes in the practice of the Patent Office, are desirable.

International Red Lead and Litharge Convention

THE negotiations for the formation of an "International Red Lead and Litharge Convention," in regard to which numerous reports have been in circulation, have now (states the *Chemiker-Zeitung*) concluded, and an agreement has been signed. The agreement, the object of which is to obviate price-cutting, includes reservations whereby, in the event of unforeseen developments, the Convention may be rapidly dissolved. The basis of the agreement is the retention by the various manufacturers of their markets.

Chemical and Dyestuff Traders' Association

Speeches at Annual General Meeting

THE sixth annual general meeting of the British Chemical and Dyestuff Traders' Association was held at the Comedy Restaurant, Panton Street, London, on Wednesday. The meeting was preceded by a luncheon, at which the guests included Mr. J. Davidson Pratt, general manager of the Association of British Chemical Manufacturers.

Mr. A. F. Butler's Report

The first business at the annual meeting, at which the president, Mr. Victor Blagden, presided, was the consideration of the accounts for the year ended December 31, 1928, which



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were received and approved. The Chairman, Mr. A. F. Butler, then presented his report for the year. He said that their president, Mr. Blagden, had once more been unceasing in his work and interest in the Association. As their leader, he had, during the past year, given a great deal of time and thought to promoting the interests of the Association and, through it, the welfare of its members. He regretted to report that they had suffered the loss of the active support of Mr. Chas. Page. Mr. Page, who had been a member of the executive council since the formation of the Association, had not been in good health for some considerable time, and only that week they had received the news that he desired to resign. Under the circumstances, they had no option but to accept his resignation, but he felt sure the council would be voicing the opinion of all members of the chemical trade when they expressed sincere regret and a wish for Mr. Page's recovery of good health.

He believed he could state with confidence that once again the service rendered by the Association to individual members had given general satisfaction.

Key Industry Duties

In connection with the Key Industries Duties, the danger of an attempt to widen the scope of this legislation to cover a large number of industrial chemicals was carefully watched by the Association. About this time last year the applicants succeeded in obtaining from the Board of Trade tribunal a decision that calcium biphosphate of baking powder quality was a dutiable product. The verdict did not state it was to be dutiable because it was a "fine chemical"; in fact, it gave no reason at all. To this day, no one knew why this product was made dutiable, and those who were qualified to express an opinion on the matter were unable to suggest why it was ordered to be included in the list of articles chargeable with duty.

They immediately sought the opinion of the Board of Trade as to whether it proposed to accept the decision in this case as a

precedent and apply it to a number of other heavy chemicals which were the subject of complaint. The answer which they received was non-committal, but they believed that they might now conclude that the principle aimed at in the calcium phosphate case was not established and was not likely to be applied generally.

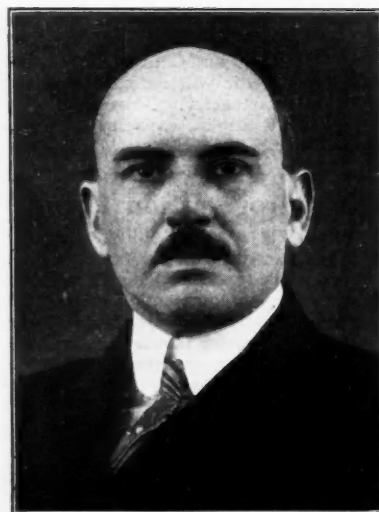
The exemption orders which were instituted in 1927 to remove duty from those products not made here continued to operate for a number of products. This revision and modification of the Key Industries Act followed three years' representations by the Association. Members should use the Association for advice as to how to proceed in making applications for exemption orders in respect of any products in which they were interested.

The Attitude of the Present Government

In view of the recent general election and of the declared intentions of the present Government in regard to import duties, they would, no doubt, expect him to say something on the subject of the future of the Safeguarding of Industries Act.

If that measure had correctly interpreted the intentions which were expressed by its sponsors at the time of its introduction, it would have been more correctly called the "Key Industries Act," but, having regard to the actual manner of its interpretation, one must say that its name was well-chosen. Their Association had always maintained that it did not quarrel with the principle of the safeguarding of certain essential key industries, but it had always taken the strongest exception to the way in which that principle had been extended in the direction of general protection to the chemical industry.

Having regard to the fact that the Government since its accession to power has made no statement of its intention in regard to the Safeguarding of Industries Act, it was impossible for him to make any official pronouncement as to the policy which their executive would adopt, but speaking personally, he would suggest that the time has come when, in the national interest, that Act should be severely limited in scope, if not entirely withdrawn, but the withdrawal or amendment of that much-disputed measure should be effected with the greatest of care and with the object of causing the least



MR. A. F. BUTLER.

possible dislocation of business. It might be desirable to give time to the trade to adjust itself to the changed conditions, and he thought it possible that they would welcome the establishment of a suitable committee, on which the traders had proper representation, to consider the whole subject and to make recommendations as to the course to be pursued.

In connection with their relations with Customs, they dealt with a matter of the first importance and one that probably affected every member. In the middle of the year the Customs Department saw fit to introduce a new form to be completed by importers when entering goods, the famous Form C.105. They were required to divulge to the department the whole of their business connections, and, if considered necessary, to allow officials of that department to go to their offices and inspect their sales ledgers and find out who were their customers and every other confidential detail of their business. A deputation consisting of their president, Mr. Mason, the secretary and the speaker (Mr. Butler) met the chief Customs officials. They submitted that while the department had the right to demand all information and documents relative to c.i.f. prices paid for imported goods, they did not appear to have authority for asking for particulars of business in this country. They intimated that they would advise their members to decline to complete it and would support them in that action. A temporary settlement was reached at that meeting, and, finally, the department of Customs agreed, so far as their members were concerned, to withdraw form C.105.

Trade Samples

During the year, the Association secured the introduction of facilities whereby trade samples of goods liable to Key Industry Duty came through duty-free without delay. A somewhat similar concession had been obtained in respect of the import of trade samples of dyestuffs. Hitherto it had been necessary to obtain an import licence in each case. Now a general licence has been issued, permitting the free import of these samples. The facilities provide for the packets of dyestuffs to come in by foreign parcel post. This method, on account of the cost, was found to be unsatisfactory, and further representations were made to the authorities. They had just heard that the latter had now approved their proposal that samples of dyestuffs be allowed to come in by foreign sample post.

The position of the merchants to-day would be very different had there been no Association to protect their interest, as throughout there had been powerful forces pursuing a policy directly contrary to their interests. There was no doubt that even to-day the merchants would experience great changes to their detriment, if the efforts and influence of the Association were missing.

The Dyestuffs Import Regulations Act would have run its course of ten years early in 1931. Already the Association had taken certain steps with a view to placing the merchants' views before the authorities. They had on many occasions protested against the unfair and improper manner in which that act had been operated, and they would certainly emphasise the chief points of their complaint to the authorities.

The meeting then proceeded to the election of officers, who were elected as follows:—President, Mr. V. Blagden; chairman, Mr. A. F. Butler; vice-chairman and hon. treasurer, Mr. S. J. C. Mason; hon. auditors, Mr. G. A. Hamilton and Mr. A. Hughes; executive council (six vacancies), Mr. F. P. Bayley (Manchester), Mr. P. F. Berk (London), Mr. Harold Gilliat (Leeds), Mr. A. E. Reed (London), Mr. J. F. A. Segner (Manchester), and Mr. Henry Wilson (Huddersfield).

Mr. Blagden's Remarks

The president (Mr. Victor Blagden) in returning thanks upon his re-election, said that he wanted to thank them all for again electing him their president. When they recalled the more important happenings of the last six or eight years, such as the introduction of import duties and other trade restrictions, and remembered, as he did, the very satisfactory part played by the Association during that time in continually resisting attempts made by the Government and by opposing commercial interests to drive the merchant trade in chemicals out of business, they would realise what the Association had done.

Their chairman had made some remarks on "safeguarding." He agreed that it was too early to say anything definite. They must first see what the new Government was going to do. The Association had no politics. It had never advocated free trade or supported protection. It had strictly confined its activities to endeavouring to restrict the scope of the key industries legislation to its proper and intended limits. They did not oppose the introduction of this legislation, being informed that it would refer only to "key" chemicals. They had, however, continually protested against the manner in

which, after passing through Parliament, it was distorted so that it became largely a measure of ordinary protection covering a large number of chemical products that had not the remotest relation to the vital question of national safety in time of war.

Definition of a Key Industry

It might be asked what was, or rather what was not, a key industry in time of war. In 1920, when the idea of "key industries" was first conceived, the outlook was totally different from that of to-day. Then the nation's mind was still influenced by thoughts of war; to-day, it was possible to look at the matter more calmly and sanely. The introduction of legislation of this character for the reasons given in 1920 would not now be tolerated. Another point that must be considered was whether the industry, which now included tremendously powerful combines and syndicates, really needed further protection. In his opinion, the growth of import tariffs of recent times had been a big incentive to the formation of combines and syndicates. The danger to the consumer of this combination of import barriers and the fusion of hitherto competitive sources of supply in the home market must be obvious. It was fair to say of many price agreements, allocations of markets and similar arrangements, all of which were detrimental to the consumer, that they have been built up on the corner-stone of an import duty and would collapse if it were withdrawn.

The question of the undoubted harm of taxing raw materials was one that would have to be considered. The consuming industries, the producers of finished goods for export, had carried the burden of the 33½ per cent. tax for six years, and relief would be a welcome stimulant to many struggling industries which used chemicals as raw material.

Attitude of the Association

As the representative organisation of chemical merchants in this country, it would be their duty when the time came to see that proper and fair evidence from the merchants was given to the Government. They would watch developments, and maintain their policy of not objecting to any measure considered necessary which was based on, and rigidly limited to, securing the safety of the nation in time of peril, but they would resist and oppose the continuance of the present or the introduction of any new import duties on the raw materials they traded in, which were nothing more than ordinary protective duties levied with the object of benefiting one particular commercial interest, and which did not help to ensure the safety of the nation in time of peril in the slightest degree.

Salesmanship

There had been an outcry lately, heralded from high quarters in the land, that British salesmanship was out of date and needed changing, and manufacturers were being urged to give this close consideration. He challenged that statement. No country had a better sales organisation than Great Britain, with its old-established merchants having ramifications in all parts of the globe. They were the intelligence officers of industry, and had been, and were, doing their job very well, taking great risks, owing to the difficulties of these post-war days. What was needed was that they should receive whole-hearted support from all quarters, instead of attempts being made in several directions to displace them. Let the British manufacturers co-operate with them. It would be greatly to the manufacturers' interest to do so.

Paints and Varnishes for South America

H.M. CONSUL-GENERAL at Guatemala (Mr. H. A. Grant Watson) has forwarded to the Department of Overseas Trade a short memorandum on the market for paints, varnishes and linseed oil in Guatemala. British firms desirous of receiving a copy of this memorandum should apply to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference Number B.X. 5,408 should be quoted.

H.M. Consul-General at Mexico (Mr. J. B. Browne) has also forwarded to the Department a short memorandum on the market for paints, varnishes, etc., in Mexico. British firms desirous of receiving a copy of this memorandum should apply to the Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. Reference Number B.X. 5,410 should be quoted.

Chemistry and Materia Medica

Mr. R. R. Bennett's Address to the British Pharmaceutical Congress

On Tuesday, Mr. R. R. Bennett, B.Sc., F.I.C., (of British Drug Houses), who was chairman of the annual meeting of the British Pharmaceutical Congress held at Dublin during the week, delivered an address on "The Changing Foundations of Materia Medica." The more important parts of the address appear below.

IN spite of the ever-increasing nerve strain which results from modern conditions of business and social life, the health of the nation is to-day maintained at a higher level than ever before in the world's history. This improvement of public health is due to advances in hygiene and preventive medicine, and to the therapeutic utilisation of various physical means of influencing the tissues and functions of the body, but also it is dependent in no small measure upon the use of some of the modern drugs and medicinal chemicals which are available for the prevention and cure of disease.

The insulin treatment for diabetic persons, the effective use of vitamins in correcting the ills occasioned by deficiencies in our dietary, the value of fresh liver and liver extracts in pernicious anæmia are instances of the recent contributions made by scientific research to medical practice. Nor must we

sides there set in an intensive study of ephedrine. It has only about one-fiftieth the activity of adrenaline, but its action is more prolonged, and it has the further great advantage that it can be administered by the mouth.

Among the achievements of recent years has been the replacement of the active principles of certain natural products by identical substances synthetically produced at a cost which compares favourably with that of the natural article. The price of synthetic thyroxine is half that of the natural product obtained from the thyroid gland. Another case in point is the replacement of natural ephedrine by the synthetic product, but the latter does not possess the same therapeutic activity as the natural alkaloid.

Synthetic Drugs

In addition to the substances which occur naturally in the vegetable and animal kingdoms, there is an enormous number of drugs possessing valuable medicinal properties which are obtained solely by synthetic chemical processes. The natural alkaloid cocaine was for years the leading local anæsthetic, but its toxic properties led to a search for substitutes. As a result, many synthetic local anæsthetics have been introduced; their toxicity is less than that of cocaine, but at the same time their anæsthetising power is also less. Their usefulness depends on the ratio between their toxicity and their anæsthetic power. This group includes amongst others ethocaine, borocaine, eucaine, and stovaine.

Avertin, which is tribrom-ethyl alcohol, is the latest addition to the drugs at the disposal of the anæsthetist. A great deal of work has been done also in the development of the use of synthetic dyes in therapeutics. Dyes are absorbed by vegetable and animal cells, and that they have a selective action is shown by their use in microscopy, whereby different dyes are made to stain different constituents of the same cell. They also have a selective action on particular bacteria. The study of dyestuffs has been directed to the treatment of disease due to protozoal infections, and some very useful compounds have been discovered.

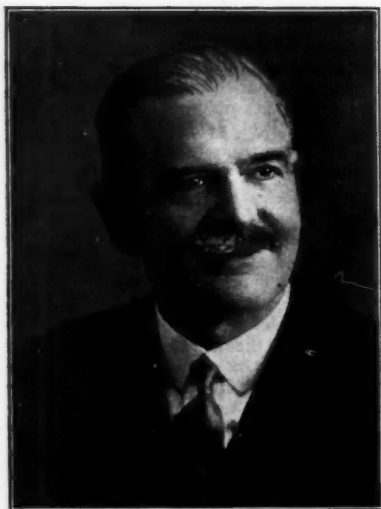
Some of the dyestuffs first studied for their trypanocidal effects have been found more effective as bactericides, as, for example, acriflavine and auramine. These dyes are of high bactericidal value in the treatment of wounds, and, being non-toxic and free from irritant action, they do not retard the healing process.

Mercurochrome

The powerful antiseptic properties of the inorganic salts of mercury have been known for many years, but their field has been limited on account of their destructive action upon animal tissue. The search for an actively antiseptic organic mercury compound which possesses the antiseptic properties of the inorganic mercury salts, and is at the same time free from the disadvantages of the latter, has resulted in the discovery of mercurochrome—the sodium salt of dibrom-hydroxy-mercuri-fluorescein, a dye belonging to the phthalein series. Mercurochrome possesses a powerful antiseptic action on bacteria.

Another notable trend is the increasing attention which is being paid to organic compounds of iodine. The adoption of the ammonium salt of ortho-iodoxy-benzoic acid as a specific for arthritis must be noted. Tetraiodophenolphthalein has been successfully applied in X-ray technique for cholecystography, while iodo-hydroxy-quinoline sulphonate, known as yatren and quinoxyl, has been found useful in the treatment of amoebic dysentery. The control and cure of protozoal diseases by means of various organic compounds of arsenic and antimony is an achievement of outstanding importance. There are numerous arsenical specifics for syphilis, sleeping sickness, amoebic dysentery and other tropical diseases.

Modern medicine depends so largely upon the synthetic products of the laboratory for defence against disease that some reference must be made to the relationship between physiological action and chemical constitution. Such study



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forget the great progress made in the preparation of medicines which help to make the disease-ridden lands, within and without the Empire, safe for the white man. Without these remedies, British colonisation and trade in the tropical and sub-tropical countries, which form so important a part of our great Empire, would be seriously handicapped, and could only be carried on at the cost of many valuable lives.

Active Principles

In the past, many of the drugs used in the treatment of disease were plant or animal products. The preparations available for administration were not elegant and perhaps not always active. To-day we live in an age of standardised products, while isolated active principles to a considerable extent have replaced the parent drug. Morphine, cocaine, atropine, quinine and emetine are a few of the older well-known examples of the active plant alkaloids which in a large measure have replaced in medical practice the drugs in which they occur. More recently, ergotoxin has been made from ergot on a commercial basis.

The alkaloid ephedrine was isolated nearly half a century ago, but only within the last three or four years has it been introduced for the treatment of asthma and hay fever. Ephedrine is obtained from a plant which is mentioned among the materia medica of one of the Chinese emperors over 2,000 years before the Christian era. Down through the centuries, under the name Ma Huang, it has been a prized ingredient of Chinese folk medicine. In 1924 interest in ephedrine was aroused by a demonstration of its close chemical and pharmacological relationship with the animal hormone, adrenalin. On all

as chemists and biologists have made of the influence of chemical constitution on physiological action has shown that a small difference in constitution may profoundly influence activity. However, no simple laws correlating chemical constitution and physiological action have, as yet, been deduced.

The science of chemotherapy, or the treatment of infections by the use of synthetic substances, is substantially the outcome of Ehrlich's side-chain theory. Ehrlich advanced the theory that there was an affinity between certain chemical groupings and the protoplasm of micro-organisms, but this theory is fast losing sway, and the view is gaining credence that all the chemotherapeutic substances destroy micro-organisms indirectly by increasing the combative action of the host's protective mechanism.

A start has been made in organising chemotherapeutic research through a permanent committee of chemists and biologists, while a separate committee will organise and direct the necessary clinical trials of substances which are likely to be of importance in medicine. The establishment of a chemical research laboratory at Teddington, under the general scheme of research directed by the Department of Scientific and Industrial Research, must be regarded as an experiment of great interest. This laboratory is working in collaboration with the Medical Research Council in an endeavour to obtain experimental evidence of the relationship between chemical constitution and physiological activity. New compounds produced at the laboratory are considered from the point of view of their possible practical application, and with the facilities afforded by co-operation with the Medical Research Council, compounds likely to be valuable for therapeutic use are tested physiologically.

The science of the function of the vitamins in nutrition may be said to date from 1912, the year in which Hopkins made known his classical discovery that to maintain animal life the diet must contain, in addition to the substances generally accepted as dietary essentials, a sufficiency of accessory food factors, or vitamins as they were afterwards named. During the years which have passed since 1912, our expanding knowledge of the vitamins has led with increasing conviction to the conclusion that normal health is only maintained if an ample supply of vitamins is present in the diet.

The significance of iodine has been dealt with very exhaustively in the Medical Research Council's recent report on iodine in nutrition. It is shown that iodine stands in a very intimate relation to biological processes, and that neither the animal nor the vegetable world can remain indifferent to its presence or absence.

Agreement between I.C.I. and Chile Step towards Regulating Fertiliser Markets

It is officially announced that an agreement has been arrived at between the Chilean Finance Minister, Señor Pablo Ramirez, and Imperial Chemical Industries, Ltd., having for its purpose closer co-operation between synthetic nitrogen products and Chilean nitrate, on similar lines to the agreement concluded between the Chilean Finance Minister and the I.G. Farbenindustrie A.-G., which agreement is announced concurrently. An agreement has also been concluded between Imperial Chemical Industries and the I.G. Farbenindustrie A.-G., with regard to co-operation between those two companies in the production, marketing, and propaganda of synthetic nitrogen products.

The agreements provide for a common policy to be pursued in the future regarding propaganda and similar matters relating to fertilisers. A substantial basis for the stabilisation of the nitrogen industry has thus been reached, and it should be noted that this stabilisation is accompanied by a substantial reduction in the prices of nitrogenous fertilisers, amounting to 10s. per ton. This is a matter of great importance to the agricultural industry of the world. Even before this latest reduction, the prices of nitrogenous fertilisers were substantially lower than they were before the war. The large nitrogen producing groups are therefore making a considerable effort to assist farmers in the crisis through which the agricultural industry is passing. The agreement between the three largest producers of nitrogenous fertilisers in the world, outside the United States, should pave the way for a stabilisation of the nitrogen industry, inasmuch as it is proposed to invite the other national groups of nitrogen producers to come into line.

John Benn Hostel Dinner

£950 for H. G. Wells MS.

LORD MELCHETT presided at the annual dinner of the East End Hostels Association, which was held on Tuesday night at the Savoy Hotel.

During the evening Sir Ernest Benn sold by auction Mr. H. G. Wells's MS. of "Æpyornis Island," which realised £950, and was knocked down to Mr. Gordon Robbins, acting on behalf of an undisclosed bidder.

Sir Ernest Benn said the manuscript was written in 1894 and was published for a fee of nine guineas in the *Pall Mall Budget*. Any publisher in London to-day would gladly pay 1,000 guineas for a like privilege. It was of 23 quarto folios and entirely written in Mr. Wells's own handwriting. It was his first manuscript to be sold, and so far as was known was the only manuscript of Mr. Wells's extant, for in later years he had used the typewriter.

Proposing the toast of "The London Boy," Sir Tudor Walters, M.P., said he was of opinion that the London boy comprised probably the finest human raw material in the world. He possessed many distinctive qualities, and the most notable was his alertness. The spirit that pervaded the John Benn Hostel made for a new England. The boys themselves contributed £2,200 annually towards its upkeep. The courage and determination of the London boy conquered the whole world. He could turn his hand to anything, and knew not the maxim of "one man, one job." During the war he had a record of which any race might well be proud.

The Dean of St. Paul's, in support of the toast, said that the institution was doing wonderful work, though it might be said that it was a mere "drop in the bucket." His experience as a clergyman, however, was that the most useful work was done with individuals. The hostel had turned out scores of good men and worthy citizens.

Captain Wedgwood Benn, M.P., responding, said that the London boy was the enemy of pomposity and sham. He gave real friendship in return for friendship that was offered on terms of equality.

Proposing "The East End," Dr. Alington, Headmaster of Eton, said that, though all classes of the community in England had common defects, they possessed virtues in equal proportion. Those virtues were to be found in the East End, as in any other part of the country, and in saying that he was paying the East End a very high compliment.

Mr. A. P. Herbert replied.

Proposing "The John Benn Hostel," the Chairman said it was founded in memory of Sir John Benn, and was being supported and carried on to-day by Sir Ernest Benn. It formed an example which should be extended and followed. Besides the £2,200 that the boys contributed, another £4,000 was needed to make up the running expenses. They hoped to raise that night at least £2,000 by contributions. He would be glad to contribute £100 towards the fund.

Lord Feversham acknowledged the toast.

Among the guests were Dr. G. T. Morgan, F.R.S., Mr. J. Davidson Pratt, Major Hodgkin, Mr. H. T. F. Rhodes, Commander Ellis, etc. As a result of the dinner, the Hostel will benefit to the extent of over £2,000.

"Red Triangle" Cement Merger

THE announcement is made in the report of the Ship Canal Portland Cement Manufacturers that, in the opinion of the directors, the time has arrived for the practical merger of the share holdings in Greaves, Bull and Lakin, Holborough Cement, and in the ordinary shares of the Dunstable Portland Cement, by means of an exchange of fully-paid ordinary shares of Ship Canal Portland Cement. In conjunction with the British Cement Products and Finance Co., a plan has been formulated to effect this merger, full details of which will be given at the general meeting. The company already holds a controlling interest in these concerns, which constitute the "Red Triangle" group, so it may be assumed that the merger proposals will be carried. It is also stated that negotiations have been completed for the acquisition of an important and old-established cement manufacturing business in the south of England, while further negotiations are said to be pending.

Advantages of "Instalment Buying"

Address by American Professor

At the twenty-sixth Individualist Luncheon, held at the Hotel Cecil, London, on June 19, Professor Edwin R. Seligman, who occupies the Chair of Economics at Columbia University, New York, addressed a large gathering of professional and business men on the subject of "Instalment Buying." Sir Donald Maclean, M.P., presided.

What "Instalment Buying" Means

Professor Seligman, in the course of his address, expressed the conviction that the prevalent and growing custom of purchasing articles and goods of all descriptions by a series of deferred payments was of far greater moment than might first appear on the surface, for, in his opinion, the system formed the foundation of a great fundamental economic development which would eventually enable every worthy citizen to take his rightful place in the progress of civilisation, and which would assist more than anything else in bringing about that equality of wealth and participation in the advantages of civilisation for which they all hoped.

The system of instalment buying embraced, he said, a method of enabling the individual who was not in a position to acquire an article at once by the payment of a lump sum to do so by the payment of a fraction of the cost of the article at stated intervals of time, and it actually represented an attempt to apply to the consumer as well as to the producer those methods of credit which had made Great Britain the greatest example of enterprising business operations and the greatest credit structure in the world.

In so far as it concerned public affairs, the instalment system was almost as ancient as civilisation itself, but it was only within comparatively recent times that it had become applicable to the ordinary individual and had come to be regarded as a legitimate business proposition. Originally, the system concerned chiefly those whom one might describe as "low grade" purchasers—the improvident and impecunious—enabling them to secure minor luxuries of which they did not really stand in need, but, during the past decade or so, commencing in the United States and spreading gradually through Great Britain and then the rest of Europe, the system had become more and more a part of the economic existence of the middle and upper classes, and was now being applied to housing, the motor car industry, and other conveniences and even necessities of everyday life.

Objections Answered

It was only to be expected that such a revolutionary method of trading would at first meet with much adverse criticism and prejudice on the part of conservative business men and the banking fraternity—opposition on the Continent was greater than in this country—but it was worthy of note that what was happening in Europe to-day had had to be faced in the United States only a few years ago. There the new and true conception of the idea had gradually won out. The real understanding of the matter could best be arrived at by considering what was the effect of the working of the system on all parties concerned—producer and consumer, banker, and business man.

Dealing with the problem from the point of view of economic principles, the difference between productive and unproductive credit had been a vexed question with economists since the time of John Stuart Mill, but the more modern analysts had come to the conclusion that the former distinctions were inadequate, and had now substituted for them the theory of utilisation. The argument was sometimes put forward that the system was all wrong because it catered for consumers' credit rather than for producers' credit, but that argument was unsound, being entirely opposed to the present-day conception of utilisation, and was no longer accepted by the economist. Financing the consumer was, in the long run, the same as financing the producer, since it encouraged increased consumption, to meet which further production was necessary.

Another objection, which was once prevalent also in the United States, was that the instalment system, while permissible when applied to the purchase of necessities, encouraged extravagance and the use of luxuries to an unjustifiable extent. But it was essential to realise just what was meant by a luxury, for the whole modern theory of social development was

disposed to wipe out the distinction between luxuries and necessities. No doubt the first man to don a shirt incurred the displeasure of his fellows; in any country that was making headway, the luxury of yesterday was the comfort of to-day and the necessity of to-morrow.

As regards the manufacturer, one beneficial effect of instalment buying had been to equalise production throughout the year and eliminate seasonal fluctuations. Such had been the case with the motor car industry, in which instance the system had secured mass production and standardisation. In the United States, after a careful investigation of its advantages and possibilities, the system had been applied even to the buying and selling of coal, and was now being carried on systematically with great success.

The system was, of course, open to abuse, but in the United States it had been worked with less loss than that which attended ordinary banking and mercantile business, and in that country there was already a chain of banks which lent money to individuals without any security at all, while yet another scheme was being investigated by which the instalment plan would become applicable to capital investment. By assisting a customer to purchase an article by a series of small payments, his utility to the community as a whole was increased, and the time had arrived when opportunities would be realised for providing the working man with the same advantages accruing by capital investment as the capitalist himself.

Benn Brothers Annual Outing

Firm's Jubilee Next Year

THE annual outing given by the chairman and directors of Benn Brothers, Ltd., to the combined staffs of the firm and its associated companies took place on Saturday, June 15, when a party of some 250 travelled by special train from London to Eastbourne for the day.

Shortly after their arrival at Eastbourne, luncheon was served by the well-known firm of Hammick's, in the Saffrons Room. Sir Ernest Benn (who was accompanied by Lady Benn) presided. In proposing the toast of "The King," the chairman referred to the associations between the firm and the royal family, through the personal interest taken by the Queen, Princess Mary, and the Prince of Wales in the work of the John Benn Hostel.

The toast of "The Firm" was proposed by Mr. H. Duck, chairman of the Social Circle Committee, in a humorous speech.

In responding to the toast, Sir Ernest Benn, who was very cordially received, reminded the company that next year the firm would attain its jubilee, and invited members of the staff to submit suggestions for suitable methods of celebrating the event. They would, he said, be interested to hear that their annual bonus of 7½ per cent., which had been paid for several years now, would again be distributed at the end of the month. He thanked the staff for the voluntary fund they had opened at Bouverie House on behalf of the John Benn Hostel, and said that it was a great encouragement to hear of the staff's personal interest in the splendid work and their substantial financial contribution to the funds.

A reference to the appointment of his brother, Captain Wedgwood Benn, as Secretary for State for India was received with cheers, the staff having already sent him a telegram of congratulation on his appointment. Another reference, that was received with equal cordiality, was to the forthcoming marriage of Mr. John Benn (Sir Ernest's eldest son) to Miss Ursula Hankey, daughter of Sir Maurice Hankey, secretary to the Cabinet.

Sir Ernest, in conclusion, remarked that, while Benn Brothers was a family business, he was proud to think that it comprised the larger family assembled that day—a great fellowship of workers, as it had been described in the beautiful address presented to Lady Benn and himself on their silver wedding. He trusted that that spirit would always remain in the firm, and that they would all cultivate the idea of doing work, not merely because it produced a profit, but because the work itself was worth while.

After a pleasant afternoon, spent in excursions or on the sea front, the party reassembled for tea, when Mr. Gordon Robbins (deputy chairman) presided, and later returned by their special train to London.

From Week to Week

FATAL INDUSTRIAL ACCIDENTS reported during May included five in the chemical industry.

UNIVERSITY NEWS.—*Bristol*: The following have been awarded the Ph.D. degree in chemistry: R. Buckingham, M. C. Field, and F. Roffey.

REPORTS IN THE GERMAN TECHNICAL PRESS state that representatives of I.C.I. have been sent to Angora to discuss the establishment of a fertiliser industry in Turkey.

MR. E. R. CANNING, chairman of the directors of Canning and Co., chemical manufacturers, of Constitution Hill, Birmingham, has been made a justice of the peace for that city.

A COAL DISTILLATION PLANT is to be erected at Leacroft, Cannock, Staffordshire. The Vandergrift process, which it is claimed has been successful in the United States, is to be used, and it is expected that about 1,400 tons of local coal will be required weekly.

THE GRAESSER-MONSANTO CHEMICAL WORKS, LTD., in the course of overhauling its sales organisation, has closed its Manchester office. Captain James Luck has returned to London in his capacity of manager of the advertising and general propaganda side of the business.

MADAME CURIE, the distinguished French scientist, was invested with the honorary degree of Doctor of Laws by the University of Glasgow on Wednesday, June 19. On Thursday, June 20, at a meeting of the Town Council, she was made a Guild Sister and Freeman of Glasgow.

RED OXIDE OF IRON of high grade occurs naturally on the island of Hormuz, in the Persian Gulf, about 1,000 miles south-west of Baghdad. The production is at the rate of 3,500–5,000 tons annually, about 60 per cent. going to London and 20 per cent. each to the United States and Calcutta.

THE "TRANSACTIONS OF THE FUEL CONFERENCE, World Power Conference, London, 1928," contains a full report of the papers read by many specialists during the course of the ten-days' conference, and is now available at the price of £12. It comprises three volumes of some 1,300 pages each, and in all it runs to approximately a million and a half words.

AN EXTRAORDINARY GENERAL MEETING of the Lautaro Nitrate Co. has been called for August 22 to consider resolutions affecting the articles of association. Upon the adoption of the new articles of association, meetings will be called to approve and ratify the arrangements that have been entered into with the Anglo-Chilean Corporation and other companies.

A CONTRACT has, it is understood, been signed for the issue of £3,000,000 series "C" 6 per cent. bonds of the Potash Syndicate of Germany, this being the balance of the authorised issue of £15,000,000. A portion of the bonds will be issued in Holland and Switzerland, but the greater part will be placed privately at 96 per cent. by J. Henry Schroder and Co. and Higginson and Co.

ARRANGEMENTS FOR THE CONSTRUCTION of new chemical plant and works at Stockton, in association with the Billingham synthetic nitrogen works of Imperial Chemical Industries, are reported to be under consideration. The undertaking will be under the management of a subsidiary concern with similar works on Tyneside. The enterprise at the outset is expected to provide employment for 250 workers.

THE SAFETEX SAFETY GLASS CO., in its first report, covering the period to January 12, states that production at Hendon factory did not commence until October, 1928, and after that date technical difficulties and training of employees prevented efficient working. The profit and loss account shows a debit balance of £7,352. It is stated that an increasing demand has been received for anti-dazzle safetex, which was introduced to the motor trade recently by the company.

UNEMPLOYED INSURED PERSONS in the chemical industry in Great Britain and Northern Ireland at May 27 numbered 6,366 (males 5,588, females 778); in explosives manufacture, 721 (males 525, females 196); in paint, varnish, japan, red and white lead manufacture, 680 (males 565, females 115); in oil, grease, glue, soap, ink, match, etc., manufacture, 4,567 (males 3,743, females 824). The percentages of insured persons in these industries unemployed at the same date were 6.3, 3.6, 3.6 and 6 respectively.

THE DIRECTORS of Apex (British) Artificial Silk report that the erection of additional plant to bring the output up to 5 tons will be completed within a few weeks of the time specified. In the meantime the plant has not been working at full pressure owing to the present condition of market. Owing to increasing supplies of yarn early in the year, users became more exacting as to quality, and prices have not been remunerative. It has been decided, therefore, to concentrate on improvement of quality of yarn and elimination of source of loss. Processes for the manufacture of cellulose acetate have been considerably improved. In view of market conditions referred to, it may be necessary to effect some selling arrangements with other companies, and negotiations are in progress to that end.

THE COMITE DES INDUSTRIES CHIMIQUES DE FRANCE announces that its address is now 23, rue de Balzac, Paris VIII, France.

SIR EDWARD BROTHERTON, upon whom the King recently conferred a barony, has taken the title of Baron Brotherton of Wakefield.

DR. ARTHUR D. LITTLE, president of the Society of Chemical Industry, arrived at Southampton on Saturday last from Cambridge, Massachusetts.

DR. L. V. REDMAN, vice-president of the Bakelite Corporation, has been elected president of the Chemists' Club, New York, in succession to Dr. T. B. Wagner.

MR. F. P. BOWDEN (Cambridge and Tasmania) has been awarded an 1851 Scholarship for research in physical chemistry; while Mr. B. Woolf (Cambridge) receives one for research in biochemistry.

THE COMPANHIA UNIAO FABRIL, said to be the largest manufacturing organisation in Portugal, reports its superphosphate output for 1928 as 240,000 tons, an increase of 100 per cent. over the previous year.

MR. E. G. V. PERCIVAL, B.Sc., of Coalville, who has spent four years at Birmingham University, has been awarded a Fellowship of the McGill University, Montreal, where he will be engaged in research in connection with the chemistry of wood pulp.

DISEASES OF OCCUPATIONS in Great Britain and Northern Ireland reported during May included one case of aniline poisoning and four cases of chrome ulceration (including one in the manufacture of bichromates and one in the dyeing and finishing trade).

PHOSPHATE ROCK has been found to exist in paying quantities in the interior of Brazil at Ipanema, Cabreuva and Cascaval. Plans are being made by the Government to import modern machinery and start working immediately the deposits at Ipanema.

THE WEDDING took place recently at the Keighley Parish Church of Mr. Herbert Frederick Poole, metallurgical chemist at the Keighley Laboratories, Ltd., and Miss Kathleen Cryer, of Inglefield, Skipton Road, Keighley. The bride's father is Deputy Mayor of Keighley and a representative of the town on the West Riding County Council.

THE HON. J. E. BROWNLEE, Prime Minister of Alberta, has declined to accept an offer made by Sir Thomas Tait and his associates of the Canadian Salt Co. to develop the recently-discovered salt deposits of the McMurray area in northern Alberta. The Premier bases his refusal on the grounds that the promised development was on too small a scale, and the concessions asked for too great.

A VISIT TO THE WORKS of J. S. Fry and Sons, Ltd., chocolate and cocoa manufacturers, of Somerdale, near Bristol, has been arranged for Tuesday, July 16, by the South Wales Section of the Society of Chemical Industry. The party will leave Cardiff in the morning and will return by an evening train. Further particulars may be obtained from the Assistant Hon. Secretary, at the Technical College, Cardiff.

MAY AND BAKER, LTD., of Battersea, London, have issued a new and up-to-date catalogue and price list (A.9) of their chemical and pharmaceutical specialties. The catalogue is beautifully produced and covers 278 pages. For ease of reference it is provided with a thumb index. The volume includes a list of synonyms and trade names, with their scientific equivalents—a list covering 40 pages, which should be of great value.

BELGIAN PRODUCERS OF LEAD have formed a sales company, the Comptoir Belge du Plomb Ouvré. A co-operative company of lead manufacturers has been formed, with a capital of 1,172,000 francs, the following being participants: Société Anonyme des Mines et Fonderie de Zinc de la Vieille Montagne; Compagnie des Métaux d'Overpelt-Lommel et de Corphalie, S.A.; Société Anonyme G. Dumont et Frères; Société Anonyme Maison Edmond Lamal; Société Anonyme La Nouvelle-Montagne; the firm of Jules André; and Pierre Nève.

MARTIN J. WOODS, aged 29, of Marsh Street, Widnes, and George Connor, aged 28, of Foundry Street, Warrington, were charged on remand at the Widnes Police Court on Monday, June 17, with stealing 17 lb. of scrap lead from the Gaskell-Deacon Works of Imperial Chemical Industries, Ltd. They were also charged with receiving the lead from some person or persons unknown. Woods pleaded guilty to stealing, and the charge of receiving against him was withdrawn by the police. Connor pleaded not guilty to both charges. Woods was sent to prison for three months and Connor was fined 20 shillings or 14 days.

THE INSTITUTION OF PRODUCTION ENGINEERS, one of the younger scientific institutions, which devotes itself mainly to the study of practical problems in modern engineering production, has acquired new headquarters in London at 48, Rupert Street, London, W.1. Mr. Richard Hazleton has been appointed general secretary to the Institution. He was formerly secretary to the Society of Technical Engineers. Mr. Hazleton sat in Parliament for thirteen years, devoting himself largely to industrial questions. He was a member of the Prime Minister's First Reconstruction Committee in 1917, and also served on the Balfour Committee on commercial and industrial policy after the war.

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ORGANIC.—The preparation of amylene with a theoretical hydrogen value. H. I. Waterman, P. van't Spyker and H. A. van Westen. *Recueil Travaux Chimiques Pays-Bas*, June 15, pp. 612-615 (in English).

The preparation of pure cyclohexene. H. I. Waterman and H. A. van Westen. *Recueil Travaux Chimiques Pays-Bas*, June 15, pp. 637-640 (in English).

Investigations on perylene and its derivatives. XXIII. K. Funke and H. Wolf.—XXIV. A. Pongratz.—XXV. A. Zinke and W. Hirsch. *Monatshefte*, Vol. 53, Part 1, pp. 1-6, 7-12, 13-22. Deals with 4:10-diaminoperylene; 3:9-dinaphthoylperylene, etc. (in German).

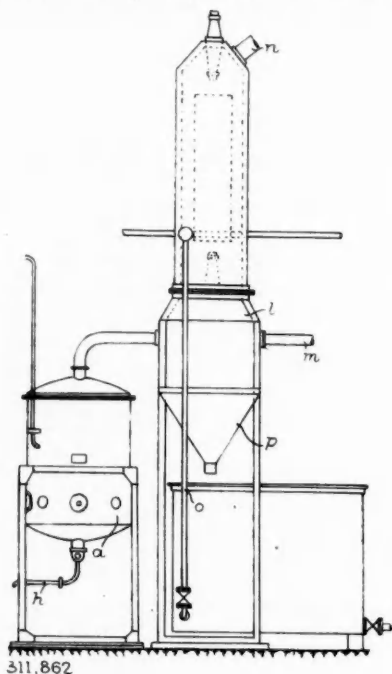
Patent Literature

The following information is prepared from published Patent Specifications and from the Illustrated Official Journal (Patents) by permission of the Controller to H.M. Stationery Office. Printed copies of full Patent Specifications accepted may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at 1s. each.

Abstracts of Complete Specifications

311,862. SULPHUR TRIOXIDE AND SULPHURIC ACID, MANUFACTURE OF. R. Tern, Villa Johanna, Zinnowitz, Germany. Application date, March 8, 1928.

The known method of oxidising sulphur dioxide by subjecting it in admixture with air to the action of high tension currents which ozonise the air, has the disadvantage of an excessive consumption of current. The object is to remedy this defect. Air is subjected to the action of high tension electric currents or fields, preferably a continuous silent discharge, such that nitrogen oxides are produced upon non-conductors provided at the ends of the current conductors, whereupon on subjecting gases containing sulphur dioxide and air to the same high tension currents or fields, the non-conductors act as catalytic agents for the oxidation of the



311,862 sulphur dioxide. The figure shows an arrangement of plant for the direct production of ammonium sulphate from sulphur trioxide so obtained. Sulphur dioxide and air admitted by a pipe *h* to the oxidation chamber *a* are subjected therein to a 60,000 volt discharge between non-conductors upon which nitrogen oxides have been formed. A blower then discharges the gas mixture containing the sulphur trioxide into an electric filter *l* supplied with ammonia gas by a pipe *m*, and with steam, preferably dry, by a pipe *o*. The ammonium sulphate precipitated falls into a box *p*, and the waste gases are exhausted at *n*.

312,007. BERYLLIUM OXIDE, MANUFACTURE OF. H. Sloman, National Physical Laboratory, Teddington, Middlesex, and A. C. Vivian, Office of Secretary for Mines, Livingstone, Northern Nigeria. Application date, August 27, 1928.

In the extraction of beryllium oxide from ores, residues, etc., there is first obtained a solution containing beryllium sulphate with various impurities. After concentrating such a solution and oxidising any ferrous sulphate present, *e.g.*, by means of hydrogen peroxide, a portion of the solution is made just alkaline with ammonia to precipitate hydrates of beryllium and other metals. This precipitate is separated and added to the remainder of the sulphate solution with thorough

agitation, and similar additions are made until a test portion of the clear liquor yields a white precipitate on addition of distilled water. The liquor is then filtered to obtain a solution saturated with basic beryllium sulphate, but containing certain impurities. The invention comprises saturating such a solution with beryllium hydrate and mixing the saturated solution with water to obtain a precipitate of beryllium hydrate containing sulphate. Effective coagulation of the precipitate is ensured by the presence of a small proportion of ammonium sulphate. The precipitate is finally subjected to a reducing roast by heating it, in admixture with substantially pure carbon, to a temperature—*e.g.*, 700° C.—below that at which beryllium oxide becomes insoluble in strong acids, and burning away excess of carbon at the same or a lower temperature.

312,093. DYES AND DYEING. R. S. Barnes, J. E. G. Harris, J. Thomas, and Scottish Dyes, Ltd., Earl's Road, Grangemouth, Scotland. Application date, Nov. 19, 1927.

Dyes are obtained by treating 2:2'-dibenzanthronyls with the Bz1 positions free, by reagents suitable for the production of sulphuric acid ester derivatives, *e.g.*, with pyridine sulphur trioxide in the presence of pyridine and a metal or after reduction with chlorosulphonic acid in the presence of pyridine. The ester is extracted in the form of an alkali salt. The starting material may be obtained from benzanthrone by treating with mild alkaline condensing agents. The products are applied to the dyeing and printing of textile fibres by their hydrolysis and oxidation on the fibres.

312,097. CHROMIUM COMPOUNDS, PROCESS FOR THE MANUFACTURE OF. I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. K. Carpmal and K. S. Carpmal, London. Application date, December 20, 1927. Addition to 259,447.

Specification 259,447 (see THE CHEMICAL AGE, vol. xv, p. 477) describes the treatment of chromium ore in a mechanical furnace with alkalis with the addition of a filler of coarse-grained ore. The melt is lixiviated with dilute sulphuric acid, and the residue used again as a filler. In this invention the coarse ore after being used several times as a filler is mixed with dolomite and worked up in the usual manner, the accumulated impurities acting as filling material. The amount of impurity is not allowed to exceed 70 per cent. before the use of the ore as a filler is discontinued.

312,243. SULPHURIC ACID ESTERS OF AMINO-ANTHRAHYDROQUINONES. D. A. W. Fairweather, J. Thomas, and Scottish Dyes, Ltd., Earl's Road, Grangemouth, Scotland. Application date, November 18, 1927.

Sulphuric acid esters of amino-anthrahydroquinones are obtained by treating acylamino-anthraquinones, particularly anthraquinonyl-urethanes with pyridine sulphur trioxide in the presence of a metal and a tertiary organic base. The resulting ester is hydrolysed to remove the acyl group, and the products may be converted into their sodium or other salts. Examples are given employing as starting materials 2-acetyl-amino-anthraquinone, 2-anthraquinonyl-urethane, 1-acetyl-amino-anthraquinone, 2-acetyl-amino-3-chloranthraquinone, and 1-acetyl-methyl-amino-4-bromanthraquinone. The amino group of the anthraquinone body is protected by acylation for a sufficient part of the process, and the acyl group then removed by the hydrolytic agent.

312,246. AROMATIC POLYHYDROXY COMPOUNDS CONTAINING MERCURY, MANUFACTURE OF. A. Carpmal, London, From I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. Application date, January 18, 1928.

These new neutral-reacting compounds are obtained by the reaction of a polyhydroxy compound of the benzene series with a mercury compound in a neutral medium such as water. Alkali such as sodium carbonate is added if necessary to neutralise any acidity of the reaction product. To carry out the reaction, a polyhydroxy compound of the benzene series is pulverised and mixed with a mercury compound, and the

mixture then dissolved. The solution may be hastened by adding a halogen salt of an alkali metal, ammonia, or an alkaline earth metal, *e.g.*, sodium chloride. Examples are given of the treatment of resorcin, 1-methyl-2:6-dihydroxybenzene, and pyrogallol with mercuric chloride. The products are employed for the treatment of seed, and as insecticides and fungicides.

312,289. AMINOHALOGEN-ANTHRAQUINONES, MANUFACTURE OF. E. G. Beckett, W. G. Woodcock, J. Thomas and Scottish Dyes, Ltd., Earl's Road, Grangemouth, Scotland. Application date, November 21, 1927.

1-Amino-5-chloranthraquinone is usually obtained from the sodium salt of anthraquinone-mono- α -sulphonic acid, but in this invention, 1:5-dichloranthraquinone is used. This substance, or a polyhalogen-anthraquinone, is treated with ammonia, and the process stopped before the amount of diamino- or polyamino-anthraquinones formed exceeds the amount of amino-halogen-anthraquinone. The amino-halogen-anthraquinones are separated by taking advantage of the differences in solubility of the components in sulphuric acid. The process is also applicable to the production of other amino-halogen-anthraquinones, *e.g.*, 1-amino-8-halogen-anthraquinone. Examples are given.

312,297. AZO DYESTUFFS, MANUFACTURE OF. O. Y. Imray, London. From I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. Application date, February 21, 1928.

4:6-Dinitro-resorcinol-dimethyl or diethyl-ether is reduced to the nitro-amino compound, benzoylated, and the benzoyl compound further reduced. The 4-amino-6-arylamino-resorcinol dialkyl or diaralkyl ether is diazotized and coupled with 2:3-hydroxynaphthoic acid arylides. Diazo components and coupling components containing groups known to render azo-dyestuffs soluble in water or not fast to alkali, such as a carboxylic or sulphonic acid group, are avoided. The products give clear violet shades fast to washing and chlorine, and in part to boiling lye. A large number of examples are given.

312,388. OXYGENATED ORGANIC COMPOUNDS. J. Y. Johnson, London. From I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. International Convention date, February 24, 1928.

A gaseous oxidising agent is passed through liquid hydrocarbons of the benzene series at a temperature of 80°-200° C. and a pressure of 50 atmospheres. Risk of explosion is avoided by greatly reducing the oxidising agent so that an explosive mixture cannot be obtained. Sufficient oxidising effect is obtained by employing increased temperature and pressure, and also catalysts such as organic compounds of the alkali or alkaline earth metals, magnesium, aluminium, or manganese, *e.g.*, the resinate, oleate, or enolate. In an example, hexane containing manganese acetyl-acetonate is treated with a current of air. The products contain lower members of the fatty acid series with 2-6 carbon atoms, and their esters. The treatment of a benzene boiling at 70° C. is also described.

312,512. PURIFICATION OF SYNTHETIC BUTYL ALCOHOL, PROCESS FOR. J. Y. Johnson, London. From I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. Application date, June 20, 1928.

When butyl alcohol is prepared by catalytic hydrogenation of synthetic crotonic aldehyde or butyric aldehyde, the product contains small proportions of acetals, nitrogen compounds, etc., which cannot be eliminated by distillation and have an injurious effect in some applications of butyl alcohol, *e.g.*, in the production of lacquers. These impurities are removed by treating with chlorine or bromine below 60° C., or with hypochlorous or hypobromous acid. The impurities are destroyed or converted into less volatile compounds which remain as a residue when the butyl alcohol is distilled. Some examples are given.

NOTE.—Abstracts of the following specifications which are now accepted, appeared in THE CHEMICAL AGE when they became open to inspection under the International Convention: 285,486 (J. R. Geigy Akt.-Ges.), relating to dyestuffs of the phenolphthalein-safranin series, see Vol. XVIII, p. 368; 285,833 (Schering Kahlbaum Akt.-Ges.), relating to thymol,

see Vol. XVIII, p. 398; 286,226 (I.G. Farbenindustrie Akt.-Ges.), relating to azo dyestuffs, see Vol. XVIII, p. 417; 286,274 (I.G. Farbenindustrie Akt.-Ges.), relating to azo dyestuffs insoluble in water, see Vol. XVIII, p. 440; 306,108 (D., M., S. R., and S. Guggenheim and J. K. MacGowan), relating to treatment of tin bearing materials, see Vol. XX, p. 39 (Metalurgical Section); 308,243 (Union Chimique Belge Soc. Anon.), relating to production of ammonium sulphate, see Vol. XX, p. 507.

International Specifications not yet Accepted

310,011. DYES. Soc. of Chemical Industry in Basle, Basle, Switzerland. International Convention date, April 19, 1928.

Soluble azo dyestuffs containing chromium are obtained by treating with an agent yielding chromium the dyestuffs produced by coupling diazotized 2-aminophenol-4:6-disulphonic acid with unsulphonated components. Specified components are 1-phenyl-3-methyl-5-pyrazolone and its 3¹-sulphamido and 3¹-carboxy-4¹-oxy derivatives, 1-(3¹-carboxy-4¹-oxy) phenyl-5-pyrazolone-3-carboxylic acid, arylides of 2:3-oxy-naphthoic acid, resorcinol, and β -naphthol. The products have good equalising properties and good fastness to washing and fulling.

310,425. RECOVERING COPPER FROM SPENT LYES. I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. International Convention date, April 25, 1928.

Spent copper lyes containing 0.01 per cent. of copper obtained in the cuprammonium process of making artificial silk are treated with silicic acid, fuller's earth, or active carbon, to adsorb the copper, which is then leached out with sulphuric acid.

310,479. SUPERPHOSPHATE. F. C. Palazzo, 34, Via Montebello, Florence, Italy. International Convention date, April 26, 1928.

Precipitated dicalcium phosphate is treated with phosphoric acid, allowed to stand, and then dried at 50° C. under reduced pressure. The dried product is rich in water-soluble phosphate.

310,507. NITROUS OXIDE. W. Friederich, 14, Mühheimerstrasse, Troisdorf, near Cologne. International Convention date, April 27, 1928.

In the decomposition of ammonium nitrate, or a mixture of ammonium sulphate and sodium or potassium nitrate to obtain nitrous oxide, gaseous or liquid ammonia is also present.

310,529. SYNTHETIC DRUGS. Vereinigte Chemische Werke Akt.-Ges., 16, Salzufer, Charlottenburg, Berlin. (Assignees of A. Rothmann, 12, Schaumburgallee, Charlottenburg, Berlin.) International Convention date, April 28, 1928.

To obtain 6-alkoxy-5:8-diamino-quinolines, the oxyquinoline is dinitrated and the product reduced. The diamino compound so obtained is alkylated. Alternatively, the oxyquinoline is mononitrated, alkylated, and the alkoxy-mono-nitro compound further nitrated and reduced. Some examples are given.

310,534. HETEROCYCLIC BASES. I.G. Farbenindustrie Akt.-Ges., Frankfurt-on-Main, Germany. International Convention date, April 27, 1928.

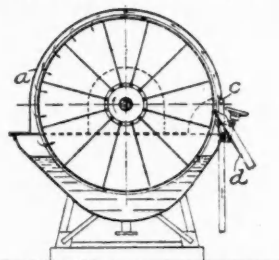
Vulcanisation accelerators and dyestuff intermediates are obtained by condensing an ether of a cyclic thiourea with a primary or secondary amine in the presence of amyl alcohol, a mercaptan being eliminated. Examples are given of the preparation of tolylamino-imidazoline, phenylamino-imidazoline, and N-(phenylmethyl)-amino-imidazolines.

310,549. AMMONIUM SALTS. C. J. Hansen, 33, Trappenbergstrasse, Essen, Germany. (Assignee of H. Koppers Akt.-Ges., Postfach, 948, Essen, Germany. International Convention date, April 28, 1928.

Thiocyanic acid and its salts are treated with an acid liquor containing sulphurous acid or a liquor capable of yielding sulphurous acid such as thiosulphuric or polythionic acids or salts. The apparatus is of chromium-nickel steel. Ammonium salts are obtained.

310,536. AMMONIUM SULPHATE. C. Still, 4, Bismarckplatz, Recklinghausen, Germany. International Convention date, April 28, 1928.

A mixture of crystals and liquor from a saturator is filtered and the crystals treated with ammonia gas to obtain neutral



310,536

ammonium sulphate. A rotating filter drum has a hood *a* and the layer of crystals is treated with ammonia gas, air containing ammonia, or ammonium carbonate vapour, which is supplied by a pipe *c* and drawn first over and then through the crystals. Or the gas may be forced from inside the drum through the crystals and then drawn back through the crystals. The crystals are removed by a scraper *d*.

LATEST NOTIFICATIONS.

- 313,487. Process of welding magnesium alloys. I. G. Farbenindustrie Akt.-Ges. June 12, 1928.
 313,562. Process for the manufacture of polyazo dyestuffs. Chemische Fabrik Vorm. Sandoz. June 14, 1928.
 313,440. Process for the manufacture of artificial rubber-like masses capable of being dispersed in water. I. G. Farbenindustrie Akt.-Ges. June 11, 1928.
 313,493. Process for the manufacture of indigoid vat dyestuffs. I. G. Farbenindustrie Akt.-Ges. June 12, 1928.
 313,446. Manufacture of ammonia salts. Montecatini Soc. Generale per l'Industria Mineraria e Agricola. June 11, 1928.
 313,453. Manufacture of highly stable sulphonc acids or their salts. Oranienburger Chemische Fabrik Akt.-Ges. June 11, 1928.
 313,503. Spinning of viscose. I. G. Farbenindustrie Akt.-Ges. June 12, 1928.
 313,569. Manufacture of artificial masses. I. G. Farbenindustrie Akt.-Ges. June 14, 1928.
 313,615. Manufacture of condensation products from formaldehyde, thiourea, and urea. Soc. of Chemical Industry in Basle. June 15, 1928.
 313,617. Manufacture of aminoalcohols. Skita, Dr. A., and Keil, Dr. F. June 15, 1928.

Specifications Accepted with Date of Application

- 283,184. Acridine derivatives. G. B. Ellis. (Chemische vorm. Sandoz.) January 6, 1928.
 284,588. Anhydrous acetic acid from its aqueous solutions, Process for obtaining. I. G. Farbenindustrie Akt.-Ges. January 29, 1927.
 285,017. Purifying phthalic anhydride, Process of. Selden Co. February 8, 1927.
 285,382. Indophenols, Manufacture of. I. G. Farbenindustrie Akt.-Ges. February 14, 1927. Addition to 286,005.
 286,272. Synthetic rubber, Manufacture of. I. G. Farbenindustrie Akt.-Ges. March 2, 1927.
 286,309. Catalytic gels, Preparation of. Silica Gel Corporation. March 3, 1927.
 286,622. Removing readily-absorbed gases, more particularly carbon dioxide and sulphuretted hydrogen, from gas mixtures by absorption in water under pressure, Process for. Ges. für Linde's Eismaschinen Akt.-Ges. March 5, 1927.
 286,660. Vat dyestuffs of the anthanthrone series, Manufacture of. I. G. Farbenindustrie Akt.-Ges. March 8, 1927.
 286,717. Substantive azo dyestuffs, Manufacture of. I. G. Farbenindustrie Akt.-Ges. March 10, 1927.
 295,257. Amino-anthraquinone derivatives, Manufacture of. Soc. of Chemical Industrie in Basle. August 4, 1927.
 296,423. Organic bases, Manufacture of. I. G. Farbenindustrie Akt.-Ges. September 2, 1927. Addition to 283,163.
 300,167. Synthetic rubber, Manufacture of. I. G. Farbenindustrie Akt.-Ges. November 7, 1927. Addition to 286,272.
 306,883. Catalytic molecular association of organic compounds. Selden Co. February 27, 1928.
 306,935. Fused caustic alkalis, Process for the continuous production of. I. G. Farbenindustrie Akt.-Ges. February 29, 1928.
 312,949. Artificial rubber, Manufacture of. J. Y. Johnson. (I. G. Farbenindustrie Akt.-Ges.) January 2, 1928.

- 312,975. Barium compounds, Manufacture of. S. Wittouck. March 3, 1928.
 313,058. Organic antimony compounds, Manufacture of. A. Carpmal. (I. G. Farbenindustrie Akt.-Ges.) February 1, 1928.
 313,061. Aldehydes and alcohols, Manufacture of. G. T. Morgan and R. Taylor. February 28, 1928.
 313,067. Polymerisation of olefines, Process for. F. Hofmann, M. Otto, and W. Stegemann. March 5, 1928.
 313,110 and 313,293. Azo dyestuffs, Manufacture of. A. Carpmal. (I. G. Farbenindustrie Akt.-Ges.) March 7 and May 23, 1928.
 313,188. Polymerisation products of diolefines, Manufacture of. J. Y. Johnson. (I. G. Farbenindustrie Akt.-Ges.) February 9, 1928.
 313,207. Chlorinated compounds of the benzene series, Manufacture of. A. Carpmal. (I. G. Farbenindustrie Akt.-Ges.) March 9, 1928.
 313,209. Complex tungsten and molybdenum compounds, Manufacture of. J. Y. Johnson. (I. G. Farbenindustrie Akt.-Ges.) March 9, 1928.
 313,316. Esters from acid amines, Production of. H. G. Smith and Imperial Chemical Industries, Ltd. June 12, 1928.
 313,233-4-5. Anhydrides of alkoxy-aliphatic acids, Manufacture of. H. Dreyfus. March 24, 1928.
 313,242. Silica and like gels, Manufacture of. H. Wade. (Silica Gel Corporation.) March 30, 1928.
 313,352. Anhydrous sodium acetate, Manufacture of. Courtaulds, Ltd., F. Adcock, N. G. Baguley, and D. L. Wilson. July 23, 1928.

Applications for Patents

- Badger and Sons, Co., E. B., and Groves, W. W. Manufacture of acetic anhydride. 18,611. June 17.
 Blagden, J. W., Clark, G. C. H., Howards and Sons, Ltd., and Simco, S. E. Separating higher alcohols from other substances. 19,132. June 21.
 Carpmal, A. and I. G. Farbenindustrie Akt.-Ges. Manufacture of anthraquinone dyestuffs. 19,127. June 21.
 Chemical Works, formerly Sandoz, and Elhs, G. B. Manufacture of sulphurized derivatives of phenol, etc. 19,260. June 22.
 Coley, H. E. Condensation of metallic vapours. 18,824. June 19.
 Coley, H. E. Reduction of ores, etc. 19,094. June 21.
 Compagnie Générale de Distillations et Cokéfaction à Basse Température et Minière (Intertrust) Soc. Anon. Low-temperature distillation of bituminous coal, etc. 18,638. June 17. (Belgium, March 15).
 Federal Phosphorus Co., Inc., and Haddan, R. Acid calcium phosphate. 19,005. June 20.
 Federal Phosphorus Co., Inc. Production of di-ammonium phosphate. 19,006. June 20. (United States, July 16, 1928).
 Groves, W. W., and I. G. Farbenindustrie Akt.-Ges. Manufacture of insoluble azo-dyestuffs. 19,131. June 21.
 I. G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Manufacture of organic iodo-halogen compounds. 19,015. June 20.
 I. G. Farbenindustrie Akt.-Ges., and Johnson, J. Y. Manufacture of halogen derivatives of dibenzanthrone, etc., series. 19,018. June 20.
 I. G. Farbenindustrie Akt.-Ges. Manufacture of vat-dyestuffs. 18,708. June 18. (Germany, June 18, 1928).
 I. G. Farbenindustrie Akt.-Ges. Manufacture of articles from viscose. 18,710. June 18. (Germany, June 19, 1928).
 I. G. Farbenindustrie Akt.-Ges. Manufacture of vat dyestuffs. 18,836. June 19. (Germany, June 19, 1928).
 I. G. Farbenindustrie Akt.-Ges. Manufacture of yellow mono-azo dyestuffs. 18,837. June 19. (Germany, June 19, 1928).
 I. G. Farbenindustrie Akt.-Ges. Manufacture of ortho-amino-carboxylic acid esters. 18,995. June 20. (Germany, June 21, 1928).
 Imperial Chemical Industries, Ltd. Manufacture of anthraquinone intermediates, etc. 18,727. June 18.
 Imperial Chemical Industries, Ltd. Destructive hydrogenation. 18,869, 18,870, 18,871, 18,872, 18,873. June 19.
 Kali-Forschungs-Anstalt Ges., and Kaselitz, O. Production of sulphates. 18,586. June 17.
 Kali-Forschungs-Anstalt Ges., and Kaselitz, O. Production of nitrates. 18,587. June 17.
 Karpati, J. Separation of tars, etc., into fractions. 18,719. June 18.
 Morton, J., and Morton Sundour Fabrics, Ltd. Dyeing animal fibres, etc. 18,893. June 19.
 Perry, W. P. Distillation of carbonaceous material. 19,086. June 21.
 Soc. of Chemical Industry in Basle. Manufacture of dyestuffs. 19,133. June 21. (Switzerland, July 13, 1928).
 Sulphur and Smelting Corporation. Production of ferric oxide. 18,678. June 18. (United States, June 22, 1928).
 Tatum, W. W. Manufacture of anthraquinone intermediates, etc. 18,727. June 18.
 Uebler, U. Production of nitrates. 18,587. June 17.

Weekly Prices of British Chemical Products

The prices and comments given below respecting British chemical products are based on direct information supplied by the British manufacturers concerned. Unless otherwise qualified, the figures quoted apply to fair quantities, net and naked at makers' works.

General Heavy Chemicals

ACID ACETIC, 40% TECH.—£19 per ton.
 ACID BORIC, COMMERCIAL.—Crystal, £30 per ton; powder, £32 per ton; extra fine powder, £34 per ton.
 ACID HYDROCHLORIC.—3s. 9d. to 6s. per carboy d/d, according to purity, strength and locality.
 ACID NITRIC, 80° Tw.—£21 10s. to £27 per ton, makers' works, according to district and quality.
 ACID SULPHURIC.—Average National prices f.o.r. makers' works, with slight variations up and down owing to local considerations; 140° Tw., Crude Acid, 60s. per ton. 168° Tw., Arsenical, £5 10s. per ton. 168° Tw., Non-arsenical, £6 15s. per ton.
 AMMONIA ALKALI.—£6 15s. per ton f.o.r. Special terms for contracts.
 BISULPHITE OF LIME.—£7 10s. per ton, f.o.r. London, packages free.
 BLEACHING POWDER.—Spot, £9 10s. per ton d/d; Contract, £8 10s. per ton d/d, 4-ton lots.
 BORAX, COMMERCIAL.—Crystals, £19 10s. to £20 per ton; granulated, £19 per ton; powder, £21 per ton. (Packed in 2 cwt. bags carriage paid any station in Great Britain.)
 CALCIUM CHLORIDE (SOLID).—£5 to £5 5s. per ton d/d carr. paid.
 COPPER SULPHATE.—£25 to £25 10s. per ton.
 METHYLATED SPIRIT 61 O.P.—Industrial, 1s. 3d. to 1s. 8d. per gall. pyridinised industrial, 1s. 5d. to 1s. 10d. per gall.; mineralised 2s. 4d. to 2s. 8d. per gall.; 64 O.P., rd. extra in all cases.
 NICKEL SULPHATE.—£38 per ton d/d.
 NICKEL AMMONIA SULPHATE.—£38 per ton d/d.
 POTASH CAUSTIC.—£30 to £33 per ton.
 POTASSIUM BICHRIMATE.—4½d. per lb.
 POTASSIUM CHLORATE.—3½d. per lb., ex-wharf, London, in cwt. kegs.
 SALAMMONIAC.—£45 to £50 per ton d/d. Chloride of ammonia, £37 to £45 per ton, carr. paid.
 SALT CAKE.—£3 15s. to £4 per ton d/d. In bulk.
 SODA CAUSTIC, SOLID.—Spot lots delivered, £15 2s. 6d. to £18 per ton, according to strength; 20s. less for contracts.
 SODA CRYSTALS.—£5 to £5 5s. per ton, ex railway depots or ports.
 SODIUM ACETATE 97/98%.—£21 per ton.
 SODIUM BICARBONATE.—£10 10s. per ton carr. paid.
 SODIUM BICHRIMATE.—3½d. per lb.
 SODIUM BISULPHITE POWDER, 60/62%.—£17 10s. per ton delivered for home market, 1-cwt. drums included; £15 10s. f.o.r. London.
 SODIUM CHLORATE.—2½d. per lb.
 SODIUM NITRITE, 100% BASIS.—£27 per ton d/d.
 SODIUM PHOSPHATE.—£14 per ton, f.o.b. London, casks free.
 SODIUM SULPHATE (GLAUVER SALTS).—£3 12s. 6d. per ton.
 SODIUM SULPHIDE CONC. SOLID, 60/65.—£13 5s. per ton d/d. Contract, £13. Carr. paid.
 SODIUM SULPHIDE CRYSTALS.—Spot, £8 12s. 6d. per ton d/d. Contract, £8 10s. Carr. paid.
 SODIUM SULPHITE, PEA CRYSTALS.—£14 per ton f.o.b. London, 1-cwt. kegs included.

Coal Tar Products

ACID CARBOLIC CRYSTALS.—6½d. to 6½d. per lb. Crude 60's, 2s. per gall.
 ACID CRESYLIC 99/100.—2s. 3d. to 2s. 8d. per gall. 97/99.—2s. 1d. to 2s. 2d. per gall. Pale, 95%, 1s. 10d. to 1s. 11d. per gall. Dark, 1s. 7½d. to 1s. 8½d.
 ANTHRACENE.—A quality, 2d. to 2½d. per unit. 40%, £4 10s. per ton.
 ANTHRACENE OIL, STRAINED, 1080/1090.—5½d. to 6d. per gall. 1100, 6d. to 6½d. per gall.; 1110, 6½d. per gall. Unstrained, 6½d. to 7d. per gall.
 BENZOLE.—Prices at works: Crude, 10d. to 11d. per gall.; Standard Motor, 1s. 5d. to 1s. 6d. per gall.; 90%, 1s. 7d. to 1s. 8d. per gall.; Pure, 1s. 10d. to 1s. 11d. per gall.
 TOLUOLE.—90%, 1s. 7½d. to 2s. per gall. Firm. Pure, 2s. to 2s. 2d. per gall.
 XYLOL.—1s. 5d. to 2s. per gall. Pure, 1s. 8d. to 1s. 9d. per gall.
 CREOSOTE.—Cresylic, 20/24%, 7½d. to 7½d. per gall.; Heavy, 6½d. to 6½d. per gall. Middle oil, 4½d. to 5d. per gall. Standard specification, 3½d. to 4½d. per gall. Light gravity, 2½d. to 2½d. per gall. ex works. Salty, 7½d. per gall.
 NAPHTHA.—Crude, 8½d. to 9d. per gall. Solvent, 90/160, 1s. 3½d. to 1s. 4d. per gall. Solvent, 95/160, 1s. 4d. to 1s. 6d. per gall. Solvent 90/190, 1s. 1d. to 1s. 3d. per gall.
 NAPHTHALENE, CRUDE.—Drained Creosote Salts, £4 10s. to £5 per ton. Whizzed, £5 per ton. Hot pressed, £8 10s. per ton.
 NAPHTHALENE.—Crystals, £12 5s. to £14 10s. per ton. Quiet Flaked, £14 to £15 per ton, according to districts.
 PITCH.—Medium soft, 3/6s. to 4/6s. per ton, f.o.b., according to district. Nominal.
 PYRIDINE.—90/140, 3s. 9d. to 4s. 3d. per gall. 90/160, 3s. 9d. to 4s. 3d. per gall. 90/180, 2s. to 2s. 3d. per gall. Heavy, 1s. 6d. to 1s. 9d. per gall.

Intermediates and Dyes

In the following list of Intermediates delivered prices include packages except where otherwise stated:
 ACID AMIDONAPHTHOL DISULPHO (1-8-2-4).—10s. 9d. per lb.
 ACID ANTHRANILIC.—6s. per lb. 100%.
 ACID BENZOIC.—1s. 8½d. per lb.
 ACID GAMMA.—4s. 6d. per lb.
 ACID H.—3s. per lb.
 ACID NAPHTHONIC.—1s. 6d. per lb.
 ACID NEVILLE AND WINTHER.—4s. 9d. per lb.
 ACID SULPHANILIC.—8½d. per lb.
 ANILINE OIL.—8d. per lb. naked at works.
 ANILINE SALTS.—8d. per lb. naked at works.
 BENZALDEHYDE.—2s. 3d. per lb.
 BENZIDINE BASE.—3s. 3d. per lb. 100% basis d/d.
 BENZOIC ACID.—1s. 8½d. per lb.
 o-CRESOL 29/31° C.—5½d. per lb.
 m-CRESOL 98/100%.—2s. 3d. to 2s. 6d. per lb.
 p-CRESOL 32/34° C.—2s. 3d. to 2s. 6d. per lb.
 DICHLORANILINE.—1s. 10d. per lb.
 DIMETHYLANILINE.—1s. 11d. per lb.
 DINITROBENZENE.—8d. per lb. naked at works. £75 per ton.
 DINITROCHLOROBENZENE.—£84 per ton d/d.
 DINITROTOLUENE.—48/50° C. 7½d. per lb. naked at works. 66/68° C. 9d. per lb. naked at works.
 DIPHENYLAMINE.—2s. 10d. per lb. d/d.
 a-NAPHTHOL.—2s. per lb. d/d.
 B-NAPHTHOL.—10d. per lb. d/d.
 a-NAPHTHYLAMINE.—1s. 3d. per lb.
 B-NAPHTHYLAMINE.—3s. per lb.
 o-NITRANILINE.—5s. 9d. per lb.
 m-NITRANILINE.—3s. per lb. d/d.
 p-NITRANILINE.—1s. 8d. per lb.
 NITROBENZENE.—6d. per lb. naked at works.
 NITRONAPHTHALENE.—1s. 3d. per lb.
 R. SALT.—2s. 2d. per lb.
 SODIUM NAPHTHIONATE.—1s. 8½d. per lb. 100% basis d/d.
 o-TOLUIDINE.—8d. per lb.
 p-TOLUIDINE.—1s. 9d. per lb. naked at works.
 m-XYLIDINE ACETATE.—2s. 6d. per lb. 100%.
 N. W. ACID.—4s. 9d. per lb. 100%.

Wood Distillation Products

ACETATE OF LIME.—Brown, £9 15s. to £10 5s. per ton. Grey, £16 10s. to £17 10s. per ton. Liquor, 9d. per gall.
 ACETONE.—£78 per ton.
 CHARCOAL.—£6 to £8 10s. per ton, according to grade and locality.
 IRON LIQUOR.—1s. 3d. per gall. 32° Tw. 1s. per gall. 24° Tw.
 RED LIQUOR.—9d. to 10½d. per gall. 16° Tw.
 WOOD CRESOTE.—1s. 9d. per gall. Unrefined.
 WOOD NAPHTHA, MISCIBLE.—3s. 8d. to 3s. 11d. per gall. Solvent, 4s. to 4s. 3d. per gall.
 WOOD TAR.—£3 10s. to £4 10s. per ton.
 BROWN SUGAR OF LEAD.—£38 per ton.

Rubber Chemicals

ANTIMONY SULPHIDE.—Golden, 6½d. to 1s. 3d. per lb. according to quality; Crimson, 1s. 4d. to 1s. 6d. per lb., according to quality.
 ARSENIC SULPHIDE, YELLOW.—1s. 9d. per lb.
 BARYTES.—£5 10s. to £7 per ton, according to quality.
 CADMIUM SULPHIDE.—5s. to 6s. per lb.
 CARBON BISULPHIDE.—£25 to £27 10s. per ton, according to quantity.
 CARBON BLACK.—5½d. per lb., ex wharf.
 CARBON TETRACHLORIDE.—£45 to £54 per ton, according to quantity, drums extra.
 CHROMIUM OXIDE, GREEN.—1s. 2d. per lb.
 DIPHENYLGUANIDINE.—3s. 9d. per lb.
 INDIARUBBER SUBSTITUTES, WHITE AND DARK.—4½d. to 5½d. per lb.
 LAMP BLACK.—£32 10s. per ton, barrels free.
 LEAD HYPOSULPHITE.—9d. per lb.
 LITHOPONE, 30%.—£23 per ton.
 MINERAL RUBBER "RUBPRON".—£13 12s. 6d. per ton, f.o.r. London.
 SULPHUR.—£10 to £12 per ton, according to quality.
 SULPHUR CHLORIDE.—4d. to 7d. per lb., carboys extra.
 SULPHUR PRECIP. B. P.—£55 to £60 per ton.
 THIOCARBAMIDE.—2s. 6d. to 2s. 9d. per lb., carriage paid.
 THIOCARBANILIDE.—2s. 1d. to 2s. 3d. per lb.
 VERMILION, PALE OR DEEP.—6s. 10d. to 7s. per lb.
 ZINC SULPHIDE.—8d. to 11d. per lb.

Pharmaceutical and Photographic Chemicals

ACID, ACETIC, PURE, 80%.—£39 per ton ex wharf London in glass containers.
 ACID, ACETYL SALICYLIC.—2s. 6d. to 2s. 8d. per lb.
 ACID, BENZOIC, B.P. 2s. to 3s. 3d. per lb., according to quantity.
 Solely ex Gum, 1s. 3d. to 1s. 4d. per oz., according to quantity.

ACID, BORIC B.P.—Crystal, 36s. to 39s. per cwt.; powder, 40s. to 43s. per cwt.; extra fine powder, 42s. per cwt., according to quantity. Carriage paid any station in Great Britain, in ton lots.

ACID, CAMPHORIC.—19s. to 21s. per lb.

ACID, CITRIC.—2s. 1d. to 2s. 2d. per lb., less 5%.

ACID, GALLIC.—2s. 8d. per lb. for pure crystal, in cwt. lots.

ACID, PYROGALLIC, CRYSTALS.—7s. 3d. per lb. Resublimed, 8s. 3d.

ACID, SALICYLIC, B.P. PULV.—1s. 5d. to 1s. 7d. per lb. Technical.—10½d. to 11½d. per lb.

ACID, TANNIC B.P.—2s. 8d. to 2s. 10d. per lb.

ACID, TARTARIC.—1s. 4½d. per lb., less 5%.

ACETANILIDE.—1s. 5d. to 1s. 8d. per lb. for quantities.

AMIDOL.—7s. 6d. to 9s. per lb., d/d.

AMIDOPYRIN.—7s. 9d. to 8s. per lb.

AMMONIUM BENZOATE.—3s. 3d. to 3s. 9d. per lb., according to quantity. 18s. per lb. ex Gum.

AMMONIUM CARBONATE B.P.—£36 per ton. Powder, £39 per ton in 5 cwt. casks. Resublimed, 1s. per lb.

ATROPHINE SULPHATE.—9s. per oz.

BARBITONE.—5s. 9d. to 6s. per lb.

BENZONAPHTHOL.—3s. to 3s. 3d. per lb. spot.

BISMUTH CARBONATE.—9s. 9d. per lb.

BISMUTH CITRATE.—9s. 3d. per lb.

BISMUTH SALICYLATE.—8s. 9d. per lb.

BISMUTH SUBNITRATE.—8s. 3d. per lb.

BISMUTH NITRATE.—Cryst. 5s. 9d. per lb.

BISMUTH OXIDE.—12s. 3d. per lb.

BISMUTH SUBCHLORIDE.—10s. 9d. per lb.

BISMUTH SUBGALLATE.—7s. 9d. per lb. Extra and reduced prices for smaller and larger quantities of all bismuth salts respectively.

BISMUTH ET AMMON LIQUOR.—Cit. B.P. in W. Qts. 1s. 0½d. per lb.; 12 W. Qts. 11½d. per lb.; 36 W. Qts. 11d. per lb.

BORAX B.P.—Crystal, 24s. to 27s. per cwt.; powder, 25s. to 28s. per cwt., according to quantity. Carriage paid any station in Great Britain, in ton lots.

BROMIDES.—Ammonium, 1s. 11½d. per lb.; potassium, 1s. 8½d. per lb.; granular, 1s. 7½d. per lb.; sodium, 1s. 10½d. per lb. Prices for 1 cwt. lots.

CALCIUM LACTATE.—B.P., 1s. 2½d. to 1s. 3½d. per lb.

CAMPOR.—Refined flowers, 2s. 11d. to 3s. per lb., according to quantity; also special contract prices.

CHLORAL HYDRATE.—3s. 1d. to 3s. 4d. per lb.

CHLOROFORM.—2s. 4½d. to 2s. 7½d. per lb., according to quantity.

CREOSOTE CARBONATE.—6s. per lb.

ETHERS.—S.G. .730—11d. to 1s. per lb., according to quantity other gravities at proportionate prices.

FORMALDEHYDE, 40%.—37s. per cwt., in barrels, ex wharf.

GUAIACOL CARBONATE.—4s. 6d. to 4s. 9d. per lb.

HEXAMINE.—2s. 3d. to 2s. 6d. per lb.

HOMATROPINE HYDROBROMIDE.—30s. per oz.

HYDRASTINE HYDROCHLORIDE.—English make offered at 120s. per oz.

HYDROGEN PEROXIDE (12 vols.).—1s. 4d. per gallon, f.o.r. makers' works, naked. Winchester, 2s. 11d. per gall. B.P., 10 vols., 2s. to 2s. 3d. per gall.; 20 vols., 4s. per gall.

HYDROQUINONE.—3s. 9d. to 4s. per lb., in cwt. lots.

HYPHOSPHITES.—Calcium, 2s. 5d. per lb.; potassium, 2s. 8½d. per lb.; sodium, 2s. 7½d. per lb., in 1 cwt. lots, assorted.

IRON AMMONIUM CITRATE.—B.P., 2s. 8d. to 2s. 11d. per lb. Green, 3s. 1d. to 3s. 4d. per lb. U.S.P., 2s. 9d. to 3s. per lb.

IRON PERCHLORIDE.—18s. to 20s. per cwt., according to quantity.

IRON QUININE CITRATE.—B.P., 8½d. to 9½d. per oz., according to quantity.

MAGNESIUM CARBONATE.—Light commercial, £31 per ton net.

MAGNESIUM OXIDE.—Light commercial, £62 10s. per ton, less 2½%; Heavy commercial, £21 per ton, less 2½%; in quantity lower; Heavy Pure, 2s. to 2s. 3d. per lb.

MENTHOL.—A.B.R. recrystallised B.P., 20s. 6d. per lb. net; Synthetic, 12s. to 14s. per lb.; Synthetic detached crystals 12s. to 16s. per lb., according to quantity; Liquid (95%), 9s. 6d. per lb.

MERCURIALS B.P.—Up to 1 cwt. lots, Red Oxide, crystals, 8s. 4d. to 8s. 5d. per lb., levig., 7s. 10d. to 7s. 11d. per lb.; Corrosive Sublimate, Lump, 6s. 7d. to 6s. 8d. per lb., Powder, 6s. to 6s. 1d. per lb.; White Precipitate, Lump, 6s. 9d. to 6s. 10d. per lb., Powder, 6s. 10d. to 6s. 11d. per lb., Extra Fine, 6s. 11d. to 7s. per lb.; Calomel, 7s. 2d. to 7s. 3d. per lb.; Yellow Oxide, 7s. 8d. to 7s. 9d. per lb.; Persulph, B.P.C., 6s. 11d. to 7s. per lb.; Sulph. nig., 6s. 8d. to 6s. 9d. per lb. Special prices for larger quantities.

METHYL SALICYLATE.—1s. 5d. to 1s. 8d. per lb.

METHYL SULPHONAL.—18s. 6d. to 20s. per lb.

METOL.—9s. to 11s. 6d. per lb. British make.

PARAFORMALDEHYDE.—1s. 9d. per lb. for 100% powder.

PARALDEHYDE.—1s. 4d. per lb.

PHENACETIN.—2s. 6d. to 2s. 9d. per lb.

PHENAZONE.—3s. 11d. to 4s. 2d. per lb.

PHENOLPHTHALEIN.—6s. to 6s. 3d. per lb.

POTASSIUM BITARTRATE 99/100% (Cream of Tartar)—97s. per cwt., less 2½ per cent.

POTASSIUM CITRATE.—B.P.C., 2s. 7d. per lb. in 1 cwt. lots.

POTASSIUM FERRICYANIDE.—1s. 9d. per lb., in cwt. lots.

POTASSIUM IODIDE.—16s. 8d. to 17s. 2d. per lb., according to quantity.

POTASSIUM METABISULPHITE.—6d. per lb., 1-cwt. kegs included f.o.r. London.

POTASSIUM PERMANGANATE.—B.P. crystals, 5½d. per lb., spot.

QUININE SULPHATE.—1s. 8d. to 1s. 9d. per oz., bulk in 100 oz. tins.

RESORCIN.—2s. 10d. to 3s. per lb., spot.

SACCHARIN.—47s. per lb.; in quantity lower.

SALOL.—2s. 3d. to 2s. 6d. per lb.

SODIUM BENZOATE, B.P.—1s. 8d. to 1s. 11d. per lb.

SODIUM CITRATE, B.P.C., 1911.—2s. 4d. per lb., B.P.C. 1923—2s. 7d. per lb. Prices for 1 cwt. lots. U.S.P., 2s. 6d. to 2s. 9d. per lb., according to quantity.

SODIUM FERROCYANIDE.—4d. per lb., carriage paid.

SODIUM HYPOSULPHITE, PHOTOGRAPHIC.—£15 per ton, d/d consignee's station in 1-cwt. kegs.

SODIUM NITROPRUSSIDE.—16s. per lb.

SODIUM POTASSIUM TARTRATE (ROCHELLE SALT).—100s. to 105s. per cwt. Crystals, 5s. per cwt. extra.

SODIUM SALICYLATE.—Powder, 2s. 2d. to 2s. 5d. per lb. Crystal, 2s. 3d. to 2s. 6d. per lb.

SODIUM SULPHIDE, PURE RECRYSTALLISED.—10d. to 1s. 1d. per lb.

SODIUM SULPHITE, ANHYDROUS.—£27 10s. to £28 10s. per ton, according to quantity. Delivered U.K.

SULPHONAL.—9s. 6d. to 10s. per lb.

TARTAR EMETIC, B.P.—Crystal or powder, 2s. 1d. to 2s. 3d. per lb.

THYMOL.—Puriss., 9s. 1d. to 9s. 4d. per lb., according to quantity. Firmer. Natural, 12s. per lb.

Perfumery Chemicals

ACETOPHENONE.—7s. per lb.

AUBEPINE (EX ANETHOL).—11s. per lb.

AMYL ACETATE.—2s. 6d. per lb.

AMYL BUTYRATE.—5s. per lb.

AMYL SALICYLATE.—2s. 9d. per lb.

ANETHOL (M.P. 21/22° C.).—5s. 6d. per lb.

BENZALDEHYDE FREE FROM CHLORINE.—2s. 6d. per lb.

BENZYL ACETATE FROM CHLORINE-FREE BENZYL ALCOHOL.—1s. 10d. per lb.

BENZYL ALCOHOL FREE FROM CHLORINE.—1s. 10d. per lb.

BENZYL BENZOATE.—2s. 3d. per lb.

CINNAMIC ALDEHYDE NATURAL.—14s. per lb.

COUMARIN.—9s. per lb.

CITRONELLOL.—10s. per lb.

CITRAL.—8s. per lb.

ETHYL CINNAMATE.—6s. 6d. per lb.

ETHYL PHTHALATE.—3s. per lb.

EUGENOL.—12s. 6d. per lb.

GERANIOL (PALMAROSA).—21s. per lb.

GERANIOL.—6s. 6d. to 10s. per lb.

HELIOTROPINE.—6s. per lb.

ISO EUGENOL.—14s. 3d. per lb.

LINALOL.—Ex Bois de Rose, 12s. 6d. per lb. Ex Shui Oil, 10s. per lb.

LINALYL ACETATE.—Ex Bois de Rose, 16s. per lb. Ex Shui Oil, 12s. per lb.

METHYL ANTHRANILATE.—8s. per lb.

METHYL BENZOATE.—4s. per lb.

MUSK KETONE.—34s. per lb.

MUSK XYLOL.—7s. per lb.

NEROLIN.—3s. 9d. per lb.

PHENYL ETHYL ACETATE.—11s. per lb.

PHENYL ETHYL ALCOHOL.—10s. per lb.

RHODINOL.—52s. per lb.

SAFROL.—2s. 6d. per lb.

TERPINEOL.—1s. 6d. per lb.

VANILLIN, EX CLOVE OIL.—18s. per lb. Ex Guaiacol, 15s. 6d. per lb.

Essential Oils

ALMOND OIL.—Foreign S.P.A., 10s. 6d. per lb.

ANISE OIL.—3s. per lb.

BERGAMOT OIL.—18s. per lb.

BOURBON GERANIUM OIL.—22s. per lb.

CAMPOR OIL (White).—1s. 6d. per lb.

CANANGA OIL, JAVA.—11s. 6d. per lb.

CASSIA OIL, 80/85%.—6s. 3d. per lb.

CINNAMON OIL LEAF.—9s. per oz.

CITRONELLA OIL.—Java, 2s. 6d. per lb., c.i.f. U.K. port. Ceylon, pure, 2s. 4d. per lb.

CLOVE OIL (90/92%).—9s. 6d. per lb.

EUCALYPTUS OIL, AUSTRALIAN, B.P. 70/75%.—1s. 10d. per lb.

LAVENDER OIL.—Mont Blanc, 38/40%, 17s. per lb.

LEMON OIL.—17s. per lb.

LEMONGRASS OIL.—4s. per lb.

ORANGE OIL, SWEET.—19s. per lb.

OTTO OF ROSE OIL.—Anatolian, 35s. per oz. Bulgarian, 75s. per oz.

PALMA ROSA OIL.—12s. 6d. per lb.

PEPPERMINT OIL.—English, 87s. 6d. per lb.; Wayne County, 14s. per lb.; Japanese, 7s. 3d. per lb.

PETITGRAIN.—8s. 9d. per lb.

SANDALWOOD.—Mysore, 30s. per lb.; 90/95%. 19s. per lb.

London Chemical Market

The following notes on the London Chemical Market are specially supplied to THE CHEMICAL AGE by Messrs. R. W. Greeff & Co., Ltd., and Messrs. Chas. Page & Co., Ltd., and may be accepted as representing these firms' independent and impartial opinions.

London, June 27, 1929.

BUSINESS during the current week has been quite satisfactory and steady; prices continue firm. Acetic acid is in particularly short supply, and the shortage is likely to last for some few weeks.

General Chemicals

ACETONE is in steady demand, with price firm at £75 to £85 per ton, according to quantity.
ACETIC ACID.—Unchanged at £36 10s. to £37 10s. per ton for 80% technical quality. Is in exceptionally short supply, which is likely to last for a few weeks.
ACID CITRIC.—Firm at 2s. 2d. to 2s. 3d. per lb., and in steady request.
ACID FORMIC.—The improved demand continues, with price steady at £42 per ton for the 85%, in free carboys.
ACID LACTIC is steady and in good demand at £43 per ton for standard quality 50% by weight.
ACID OXALIC.—Firm at £30 10s. to £32 10s. per ton, and in steady request.
ACID TARTARIC.—Firm at 1s. 4½d., less 5%, and in good demand.
ALUMINA SULPHATE.—Supplies still remain short, with prices firm at £7 15s. to £8 per ton.
ARSENIC.—Unchanged at £16 5s. per ton free on rails mines.
BARIUM CHLORIDE.—The short supply continues, particularly for early delivery, and prices very firm at nominally £11 10s. per ton ex wharf.
CREAM OF TARTAR.—Continues very firm and unchanged at £98 to £100 per ton for 99/100% B.P. quality, and a heavy demand is springing up.
COPPER SULPHATE.—Steady at about £27 to £28 per ton.
FORMALDEHYDE is in good request at about £39 per ton.
LEAD ACETATE.—Remains unchanged. White at £44 per ton, and brown at £43 per ton, with a steady demand.
LEAD NITRATES.—Is still rather slow at about £33 15s. per ton.
LIME ACETATE.—Unchanged, but in very short supply at about £18 per ton.
LITHOPONE.—Steady at £19 15s. to £22 per ton, according to quantity.
METHYL ACETONE.—The increased demand continues, with price firm at £58 to £60 per ton.

Nitrogen Products

Sulphate of Ammonia.—During the last week the demand has been weaker, and sales have been reported on the basis of £9 per ton, f.o.b. U.K. port in single bags for neutral quality, 20-6 per cent. nitrogen. It is understood that some ordinary quality has been offered at prices below these.

Home.—The price remains unchanged, but business transacted is negligible.

Nitrate of Soda.—Although the new selling organisations have greatly increased the sales, the stocks carried over will, on account of the large production, be very heavy, and lower prices for 1929/30 are confidently predicted.

Latest Oil Prices

LONDON, June 26.—LINSEED OIL was quiet. Spot, ex mill, £29 12s. 6d., now; July-August, £28 5s.; September-December, £28 7s. 6d.; January-April, £28 15s., naked. RAPE OIL was quiet. Crude extracted, £41; technical refined, £43, naked, ex mill. COTTON OIL was steady. Egyptian crude, £28; refined common edible, £32 10s.; and deodorised, £34 10s. TURPENTINE was steady. American, spot, 44s.; June, 42s. 9d.; and July-December, 42s. per cwt.

HULL.—LINSEED OIL was quiet; spot, £29 12s. 6d.; June, £29 2s. 6d.; July-August, £29; September-December, £28 15s. COTTON OIL.—Egyptian crude, spot, £28 15s.; June-August, £28 5s.; edible refined, spot, £32; technical, spot, £31 10s.; deodorised, £34. CASTOR OIL and PALM KERNEL OIL unchanged. GROUNDNUT OIL dearer; crushed/extracted, spot, £32 5s.; deodorised, spot, £36 5s. SOYA OIL unchanged. RAPE OIL.—Crushed/extracted, spot, £40 10s.; refined, spot, £42 10s. COD OIL and TURPENTINE unchanged. (The spot prices mentioned for oils are those fixed by the Hull Committee.)

South Wales By-Products

SOUTH WALES by-product activities continue to be unsatisfactory. Pitch remains dull, but prices are firm on a basis of from 34s. to 36s. per ton. Road tar is meeting with a slightly better inquiry round 10s. 6d. to 13s. per 40-gallon barrel, while crude tar is better at from 24s. to 28s. per ton. Creosote is dull and freely on offer at

CHLORATE OF POTASH.—Unchanged at £28 to £30 per ton, with a steady demand.

POTASSIUM PERMANGANATE.—Firm at 5½d. per lb. for B.P. Needle Crystals. The improved demand has continued.

POTASSIUM PRUSSATE.—The demand continues brisk, and price is unchanged at £63 10s. to £65 10s., according to quantity. It is still in rather short supply for early delivery.

SODIUM ACETATE CRYSTALS.—It is very firm at £22 10s. to £23 per ton. The standard crystals are in very short supply.

SODIUM BICROMATE.—Unchanged at 3½d. per lb., with discounts for contracts. There is a brisk demand, and the position remains very firm.

SODIUM HYPOSULPHITE.—Photographic pea crystals in good and steady request at £14 10s. to £15 per ton.

SODIUM NITRITE.—Steady and in good request at about £20 per ton.

SODIUM PHOSPHATE.—Unchanged at £12 per ton for Dibasic and £16 10s. for Tribasic, with a small inquiry.

SODIUM PRUSSATE is firm at 4½d. to 5½d. per lb., according to quantity, and in steady demand.

TARTAR EMETIC is in little better request at 11½d. per lb.

ZINC SULPHATE.—Unchanged, and steady at about £12 per ton.

Coal Tar Products

The coal tar product market remains quiet, with little change in prices to report from last week.

MOTOR BENZOL remains at 1s. 7d. to 1s. 7½d. per gallon, f.o.r. makers' works.

SOLVENT NAPHTHA is unchanged at 1s. 2½d. to 1s. 3d. per gallon.

HEAVY NAPHTHA is quoted at 1s. 2d. per gallon, f.o.r.

CREOSOTE OIL remains unchanged at 3½d. to 4d. per gallon in the North, and at 4½d. to 5d. per gallon in London.

CRESYLIC ACID is quoted at about 1s. 10d. per gallon for the 98/100% quality, and at about 1s. 8d. per gallon for the dark quality 95/97%.

NAPHTHALENES.—The firelighter quality remains at about £4 10s. per ton, the 74/76 quality at about £5 per ton, and the 76/78 quality at £6 to £6 5s. per ton.

PITCH is unchanged at nominally 37s. 6d. to 40s. per ton f.o.b. East Coast for September shipment and onwards.

from 3½d. to 4½d. per gallon. Motor benzol is quieter round 1s. 5d. to 1s. 7½d. per gallon. Solvent naphtha has only a small demand, values being unchanged from 1s. 3½d. to 1s. 6d. per gallon, while a similar remark applies to heavy naphtha at from 11d. to 1s. 1d. per gallon. Refined tars continue to be good, the demand being fair and values steady. Crude naphthalene has only a small demand, but prices are unchanged round the 80s. per ton mark. Whizzed is dull with quotations unchanged round 100s. per ton. Patent fuel and coke exports are not satisfactory, but prices are unchanged.

Branston Artificial Silk

THE report of the Branston Artificial Silk Co. for the year ended April 30 last states that production of a preliminary nature, with a quality of silk far in excess of expectations, was started on June 7, 1928. Thereafter, the report continues, as further plant came into operation, production increased daily. No trading or profit and loss account is presented with the report, but the balance-sheet contains an entry for development and experimental account, which shows that working costs from the commencement of output to date, including proportion of overhead expenses, depreciation of plant, less sales of rayon, amounted to £69,523. Preliminary expenses remain at £11,182, while debtors total £26,150, and stocks of rayon, stores, etc., are valued at £54,057. Cash is reduced from £372,360 to £298,113, and on the liabilities side creditors appear for £35,771, against £3,798. The past year, it is stated, has been a second one of uninterrupted and successful development, and the work of installation may now be considered as practically completed. In March of this year the plant was put into commission for the purpose of testing its capacity and the further training of labour, and a production slightly in excess of the guaranteed production of four tons a day was achieved; the output, adds the report, is finding a ready sale. The board have prepared a general scheme and estimate for increasing the production to ten tons a day in accordance with the original programme, and steps are to be taken in the immediate future to instal the necessary plant and machinery.

Scottish Chemical Market

The following notes on the Scottish Chemical Market are specially supplied to THE CHEMICAL AGE by Messrs. Charles Tennant and Co., Ltd., Glasgow, and may be accepted as representing the firm's independent and impartial opinions.

Glasgow, June 26, 1929.

BUSINESS in the heavy chemical market still continues to be fairly good, a great number of inquiries going around for home and export business. Prices on the whole remain firm.

Industrial Chemicals

- ACETONE.—B.G.S., £76 10s. to £85 per ton, ex wharf, according to quantity. Inquiry remains satisfactory.
- ACID ACETIC.—98/100% Glacial, £56 to £67 per ton, according to quality and packing, c.i.f. U.K. ports; 80% pure, £37 10s. per ton, ex wharf; 80% technical, £37 10s. per ton, ex wharf.
- ACID BORIC.—Crystals, granulated or small flaked, £30 per ton. Powder, £32 per ton, packed in bags, carriage paid U.K. stations. There are a few fairly cheap offers made from the Continent.
- ACID CARBOLIC ICE CRYSTALS.—Unchanged at 6½d. per lb., delivered or f.o.b. U.K. ports.
- ACID CITRIC B.P. CRYSTALS.—Quoted 2s. 2½d. per lb., less 5%, ex store, spot delivery. Offered at 2s. 2½d. per lb., less 5% ex wharf, prompt shipment from the Continent.
- ACID HYDROCHLORIC.—Usual steady demand. Arsenical quality, 4s. per carboy. Dearsenicated quality, 5s. 6d. per carboy, ex works, full wagon loads.
- ACID NITRIC, 80° QUALITY.—£24 10s. per ton, ex station, full truck loads.
- ACID OXALIC, 98/100%.—Price remains unchanged at about 3½d. per lb., ex store. Offered for prompt shipment from the Continent at 3½d. per lb., ex wharf.
- ACID SULPHURIC.—£2 15s. per ton, ex works, for 144° quality; £5 15s. per ton for 158° quality. Dearsenicated quality, 20s. per ton extra.
- ACID TARTARIC B.P. CRYSTALS.—Spot material now quoted 1s. 4½d. per lb., less 5% ex wharf.
- ALUMINA SULPHATE.—In scarce demand and price now quoted about £7 per ton, ex wharf.
- ALUM LUMP POTASH.—Unchanged at about £8 12s. 6d. per ton, c.i.f. U.K. ports. Crystal meal offered on spot at £9 per ton, ex store.
- AMMONIA ANHYDROUS.—Quoted 7½d. per lb., carriage paid. Containers extra and returnable.
- AMMONIA CARBONATE.—Lump quality quoted £36 per ton; powdered, £38 per ton, packed in 5 cwt. casks, delivered U.K. stations or f.o.b. U.K. ports.
- AMMONIA LIQUID 88°.—Unchanged at about 2½d. to 3d. per lb., delivered according to quantity.
- AMMONIA MURIATE.—Grey galvanisers' crystals of British manufacture quoted £21 to £22 per ton, ex station. Fine white crystals offered from the Continent at about £17 5s. per ton, c.i.f. U.K. ports.
- ANTIMONY OXIDE.—Quoted £37 per ton, c.i.f. U.K. ports, prompt shipment from China. Spot material unchanged at about £40 per ton, ex store.
- ARSENIC, WHITE POWDERED.—Unchanged at £18 5s. per ton, ex wharf, prompt despatch from mines. Spot material quoted £19 15s. per ton, ex store.
- BARIUM CHLORIDE.—Quoted £10 10s. per ton, c.i.f. U.K. ports, prompt shipment.
- BLEACHING POWDER.—British manufacturers' contract price to consumers unchanged at £6 12s. 6d. per ton, delivered in minimum 4 ton lots. Continental now offered at about the same figure.
- CALCIUM CHLORIDE.—Remains unchanged. British manufacturers' price £4 5s. per ton to £4 15s. per ton, according to quantity and point of delivery. Continental material on offer at £3 12s. 6d. per ton, c.i.f. U.K. ports.
- COPPERAS, GREEN.—Unchanged at about £3 10s. per ton, f.o.r. works or £4 12s. 6d. per ton, f.o.b. U.K. ports.
- FORMALDEHYDE, 40%.—Still in fairly good demand and price now quoted is £36 10s. per ton, ex store.
- GLAUBER SALTS.—English material quoted £4 10s. per ton, ex station. Continental on offer at about £3 5s. per ton, ex wharf.
- LEAD, RED.—On offer at £29 15s. per ton, ex store.
- LEAD, WHITE.—Quoted £37 10s. per ton, c.i.f. U.K. ports.
- LEAD ACETATE.—White crystals quoted £41 10s. per ton; brown on offer at about £39 10s. per ton, ex store.
- MAGNESITE, GROUND CALCINED.—Quoted £8 10s. per ton, ex store. In moderate demand.
- METHYLATED SPIRIT.—Industrial quality 64 O.P. quoted 1s. 4d. per gallon, less 2½% delivered.
- POTASSIUM BICHROMATE.—Quoted 4½d. per lb. delivered U.K. or c.i.f. Irish ports, with an allowance of 2½% for minimum 2½ tons to be taken.
- POTASSIUM CARBONATE 96/98%.—Spot material now quoted £26 10s. per ton, ex store. Offered from the Continent £25 10s. per ton, c.i.f. U.K.
- POTASSIUM CHLORATE 99½/100% Powder.—Quoted £25 10s. per ton, ex wharf. Crystals, 30s. per ton extra.
- POTASSIUM NITRATE.—Refined granulated quality quoted £19 2s. 6d. per ton, c.i.f. U.K. ports. Spot material on offer at about £20 10s. per ton, ex store.
- POTASSIUM PERMANGANATE, B.P. CRYSTALS.—Quoted 5½d. per lb., ex wharf.
- POTASSIUM PRUSSATE (YELLOW).—Offered for prompt shipment from the Continent at 6½d. per lb., ex wharf. Spot material quoted 7d. per lb., ex store.
- SODA, CAUSTIC.—Powdered 98/99%. Now £17 10s. per ton in drums; £18 15s. per ton in casks. Solid 76/77%, £14 10s. per ton in drums and 70/75%, £14 2s. 6d. per ton in drums, all carriage paid buyers' stations, minimum 4-ton lots, for contracts, 10s. per ton less.
- SODIUM ACETATE, 65%.—Crystal quality quoted about £19 15s. per ton, ex wharf. 63/78% Anhydrous quality on offer at £20 per ton, carriage paid buyers' stations.
- SODIUM BICARBONATE.—Refined recrystallised, £10 10s. per ton, ex quay or station. M.W. quality, 30s. per ton less.
- SODIUM BICHROMATE.—Manufacturers advise an advance in price of ½d. per lb., making the spot price now 3½d. per lb., delivered as from July 1, with special concession for contracts from 2½ tons up to 25 tons.
- SODIUM CARBONATE (SODA CRYSTALS).—£5 to £5 5s. per ton, ex quay or station. Powdered or pea quality, 27s. 6d. per ton extra. Light soda ash, £7 1s. 3d. per ton, ex quay, minimum 4 ton lots with various reductions for contracts.
- SODIUM HYPOSULPHITE.—Large crystals of English manufacture quoted £8 17s. 6d. per ton, ex station, minimum 4-ton lots. Pea crystals on offer at £14 15s. per ton, ex station, minimum 4-ton lots. Prices for this year unchanged.
- SODIUM NITRATE.—Ordinary quality quoted £10 12s. per ton, carriage paid, buyers' sidings, minimum 6-ton lots, usual extras for small quantities and refined qualities.
- SODIUM PRUSSATE.—Spot material quoted 7d. per lb. Offered for prompt shipment from the Continent at 6½d. per lb., c.i.f. U.K. ports.
- SODIUM SULPHATE (SALTCAKE).—Prices 50s. per ton, ex works, 52s. 6d. per ton delivered for unground quality. Ground quality, 2s. 6d. per ton extra.
- SODIUM SULPHIDE.—Prices for home consumption. Solid 60/62%, £9 per ton. Broken, 60/63%, £10 per ton. Crystals, 30/32%, £7 2s. 6d. per ton, delivered buyers' works on contract, minimum 4-ton lots. Special prices for some consumers. Spot material 5s. per ton extra.
- SULPHUR.—Flowers, £12 per ton; roll, £10 10s. per ton; rock, £10 7s. 6d. per ton; ground American, £9 5s. per ton, ex store.
- ZINC CHLORIDE 98%.—British material now quoted at £22 10s. per ton f.o.b. U.K. ports.
- ZINC SULPHATE.—Offered from the Continent at about £10 5s. per ton, ex wharf.

NOTE.—The above prices are for bulk business and are not to be taken as applicable to small quantities.

I.C.I. Preference Dividend

THE directors of Imperial Chemical Industries, Ltd., have declared, as at July 1, on the issued preference capital of the company in respect of the half-year to June 30, 1929, a dividend at the rate of 7 per cent. per annum, less income tax at 4s. in the £, to be payable on August 1, 1929, to shareholders on the register at the 1st day of July, 1929. The register of preference shareholders will be closed from July 1, 1929, to July 15, 1929, both days inclusive. In accordance with the terms of the circular to the shareholders, dated April 19, 1929, the new issue of preference shares will rank for this dividend from May 6, 1929, calculated on the amount per share by way of capital credited as paid up and from the due dates of the instalments. The half-year's dividend in question on the new preference capital for the part of the half-year will therefore be satisfied by the payment of a dividend of ·886,027d. gross, less income tax per share.

Manchester Chemical Market

(FROM OUR OWN CORRESPONDENT.)

Manchester, June 27, 1929.

ALTHOUGH in the aggregate a moderate business has been put through in chemical products on the Manchester market during the past week, selling experience has been by no means uniformly good and complaints are still rife in many quarters of the spasmodic buying by many home trade consumers, although fair deliveries of the principal heavy materials are being made against contracts. As to prices, occasional easiness is displayed in some sections, but such cases are rare.

Heavy Chemicals

Business in sulphide of sodium this week has been on rather quiet lines, the values are maintained at about £9 per ton for the 60-65 per cent. concentrated solid quality and £8 per ton for the commercial. There is a fairly steady call for bicarbonate of soda, particularly against contracts, with quotations on the basis of £10 10s. per ton. With regard to chlorate of soda, this is in moderate request, with current offers at from 2½d. to 3d. per lb., according to quantity. Alkali is moving off in fair quantities and prices are firm at £6 per ton, in contracts. Hyposulphite of soda is still only a comparatively quiet section of the market, but there has been little change in the price situation; the photographic grade is selling at from £15 to £15 10s. per ton and the commercial product at round £8 15s. Offers of prussiate of soda are not too plentiful at the moment and quotations keep very firm in consequence at from 4½d. to 5d. per lb., according to quantity. Saltcake is by no means active, but values are maintained at about £2 10s. per ton. Bichromate of soda is well held at 3½d. per lb., and buying interest in this section of the market is pretty steady. Caustic soda keeps firm at from £12 15s. to £14 per ton, according to grade and in contract parcels, and a steady trade is being put through. Offers of phosphate of soda this week have ranged from about £11 15s. to £12 per ton, with only a relatively quiet business going through.

Carbonate of potash is meeting with a fair volume of inquiry, with quotations for the 96 per cent. solid at from £26 to £26 5s. per ton. A moderate demand has been reported for chlorate of potash, sales of which have been made at round 3d. per lb. Yellow prussiate of potash continues very firm at from 6½d. to 7½d. per lb., and with a quietly steady demand about for this material offers are not excessive. Caustic potash is moving in fair quantities and quotations are fully maintained at from £33 5s. per ton for prompt delivery of one to five-ton lots. Permanganate of potash is in quiet request but prices are steady, with the B.P. quality quoted this week at from 5½d. to 5¾d. per lb. and the commercial kind at 5¼d. Quotations for bichromate of potash are in the neighbourhood of 4½d. per lb., with a fair trade being done.

The demand for arsenic on this market continues on a comparatively restricted scale, but at about £16 per ton at the mines for white powdered, Cornish coppers, there has been little alteration in prices. Sulphate of copper appears to be rather easy in tendency at the moment and the demand is only moderate; export quotations are at round £27 15s. per ton, f.o.b. Acetate of lime is quiet though values are reasonably steady again at £16 10s. per ton for the grey and from £8 to £8 5s. for the brown. The acetates of lead are about unchanged at £40 to £41 per ton for the white quality and about £39 10s. for the brown, with nitrate of lead inactive at £34 10s. per ton.

Acids and Tar Products

A shade more interest has been shown in oxalic acid during the past week, and prices are maintained at £1 11s. 6d. per cwt., ex store. A fair demand has been reported for tartaric acid at about 1s. 4½d. per lb., with citric fractionally lower at from 2s. 1½d. to 2s. 2d. per lb. There is a steady inquiry about for acetic acid, and values are well held at round £67 per ton for the glacial and £36 for the 80 per cent. commercial quality.

Quiet forward bookings of pitch are reported at round £1 17s. 6d. per ton, f.o.b. Creosote oil has not actually changed much compared with last report, but values are easy at 2½d. per gallon, naked, at works, and the demand is relatively slow. Officers of solvent naphtha are at round 1s. 2½d. per gallon, and inquiry for this is on moderate lines. Both crude and crystal carbolic are firm and in good demand; 60's is quoted at up to 2s. 1d. per gallon and crystals at 6½d. per lb., f.o.b.

Company News

"SANITAS" TRUST.—The accounts for the year to May 31 show a net profit of £64,640, against £63,166 last year.

B. LAPORTE, LTD.—The company announces that the half-yearly dividend (to June 30) on both classes of preference shares will be paid on June 29.

AUSSIG CHEMICAL WORKS.—At the annual meeting at Carlsbad last week, the net profit was stated to be £100,000, and a dividend of 20 per cent. was declared.

DISTILLERS CO.—The directors recommend a final dividend of 12½ per cent., making 20 per cent., less tax, for the year ended May 15 last, placing £500,000 to reserve, and £5,000 to fire insurance, carrying £227,990 forward. The dividend for the previous twelve months was the same, when £400,000 was placed to reserve, £5,000 was placed to fire insurance, and £212,533 was carried forward.

ROSARIO NITRATE CO.—The report for the year ended December 31, 1928, states that the gross profit and transfer fees amount to £45,971 (against £32,625), and after providing for Chilean income and municipal taxes £1,615, interest and discount £10,361, and London expenses £4,449, and amortisation of grounds and depreciation of plant and machinery £31,645, the result is a loss for the year of £2,099. Adding the balance brought forward of £59,906, there remains a debit on the profit and loss account of £62,005.

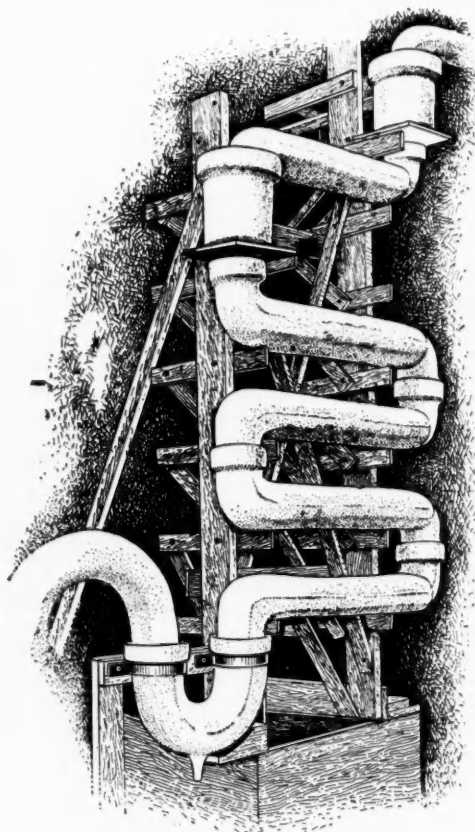
MINERALS SEPARATION.—The full report of the directors for the year ended December 31, 1928, which has now been issued, states that the profit and loss account shows a credit balance amounting to £58,599, as against £34,122 for the previous year. The directors recommend that a final dividend of 20 per cent. (equivalent to 4s. per share), less income-tax, be paid on July 1, 1929, to shareholders registered on June 21, 1929. This dividend, with the interim dividend of 5 per cent., represents a total distribution of 25 per cent. for the year, as against 12½ per cent. for 1927.

"SHELL" TRANSPORT AND TRADING CO.—Including the balance of £236,612 brought forward, there is a credit to the profit and loss account for 1928 of £5,728,686, as compared with £5,643,098 for 1927. Deducting management, legal and other expenses, which in all amount to £44,180, there remains £5,684,506, as compared with £5,600,181 last year. After payment of the dividends distributed, there remains a balance of £3,235,745, from which the directors recommend a dividend on the ordinary shares of 3s. per share, payable on July 5, making 25 per cent. for the year, the same as last year.

MAJOR AND CO.—The balance of profit and loss appropriation account brought forward was £1,252, and the profit for the year ended March 31, 1929, was £12,190, making £13,442. It is recommended that dividends be paid on June 30, 1929, of 6 per cent. on 6 per cent. cumulative preference shares for the year, £3,000; 7½ per cent. on 7½ per cent. cumulative preference shares for year, £7,500; carrying forward £2,942. A circular issued to shareholders on April 5 states that the position of the company has so far improved that the directors have hope of being able to resume the payment of dividends next year on both classes of ordinary shares.

BELL BROTHERS (MANCHESTER).—As a result of the operations for the fifteen months ended March last the debit balance on profit and loss is increased by £15,662 to £24,921. In order to extinguish this adverse balance and the preliminary expenses of £17,949, and to write down the goodwill to £6,784, the directors propose to reduce the capital by £50,000, the nominal value of the preference shares being cut down from £1 to 15s., and that of the ordinary shares from 1s. to 6d. As compensation for the sacrifice involved, preference shareholders are to have their cumulative dividend increased from 7½ to 10 per cent. per annum, and in a winding-up they will be entitled to receive 20s. per share before the ordinary shareholders are entitled to participate. It is pointed out in the report that trade was distinctly bad during the first six months of 1928, resulting in a considerable loss. A marked improvement took place and a trading profit was made in the latter half of the year, while for the three months to March last the progress was very encouraging. The improvement is being maintained.

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Economies of Floor Space and Efficiency of Operation are secured. There are no submerged joints.

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Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

CENTRAL OIL CO. (BRISTOL), LTD. (M., 29/6/29.) Registered June 15, £4,000 debenture to F. C. Baker, Bebington and executors; general charge.

IDEAL CLEANERS AND DYERS, LTD., London, W. (M., 29/6/29.) Registered June 10, £2,000 (not ex.) Land Registry charge, to Bank; charged on 5, Highbury Park, N. *£15,500. March 9, 1929.

MALEHURST BARYTES CO., LTD., Shrewsbury. (M., 29/6/29.) Registered June 11, series of debentures for £25,000, present issue £10,000; general charge. *£71,500. October 17, 1928.

Satisfactions

CHEMICAL AND DETERGENT CO., LTD., London, W.C. (M.S., 29/6/29.) Satisfaction registered June 14, £200. Registered April 6, 1929.

HINCHLIFFE (DAVID) AND SON, LTD. (old co.), Liversedge, oil refiners, etc. (M.S., 29/6/29.) Satisfaction registered June 13, £2,000, registered December 11, 1913.

London Gazette, &c.

Company Winding Up Voluntarily

SMYRNA ANTIMONY CO., LTD. (C.W.U.V., 29/6/29.) By reason of its liabilities, June 19. R. H. MacIntyre, 5, Arundel Street, W.C.2, and F. G. Trobridge, Milburn House, Newcastle-on-Tyne, appointed as joint liquidators.

Receivership

ALSACE-LORRAINE AND GENERAL PRODUCTS CO., LTD. (R., 29/6/29.) W. B. Paton, C.A., of 8, Breame Buildings, Chancery Lane, W.C., was appointed Receiver and Manager on June 15, 1929, under powers contained in debenture dated October 27, 1928.

New Companies Registered

W. HAWLEY AND SON, LTD. Registered June 15. Nominal capital £15,000 in £1 shares. To acquire the business of colour manufacturers and merchants and miners now carried on by J. Hawley and H. F. Hawley at Duffield, Derby, and elsewhere, as "W. Hawley and Son," and to carry on the business of manufacturers of and dealers in colours, paints, varnishes, lacquers, cellulose products and solvents, bituminous paints, enamels, shellac, etc. Directors: J. Hawley, Northern House, Melton Mowbray, H. F. Hawley.

HULL WASTE PRODUCTS, LTD., 1, Church Court, Old Jewry, London, E.C.2. Registered June 24. Nom. capital, £100 in £1 shares. To carry on the business of dealers in waste products for the purposes of manufacturing and dealing in all products and things which can be derived from such waste products; manufacturers of and dealers in casein, candles, soap, soda, resin, naphtha, edible fats and oils, oil bearing materials and oleaginous and saponaceous substances. A subscriber: C. Hansing, Cholesey, Berks.

STEEL INDUSTRIES OF GREAT BRITAIN, LTD.—Registered as a "public" company on June 25, with a nominal capital of £11,000,000 in £1 shares (3,500,000 6½ per cent. first cumulative convertible preference, 6,000,000 "A" ordinary, and 1,500,000 "B" ordinary). The objects are to acquire and hold the whole or any portion of the shares, debentures, debenture stock and other interests in the United Steel Companies, Ltd., and the United Strip and Bar Mills, Ltd., to adopt an agreement dated June 10 between the Austin Friars

Trust, Ltd., of the one part, and J. F. Seacombe (for this company) of the other part providing for the purchase of certain debentures and obligations issued by and shares of the two first-named companies, to carry on the business of steel and iron manufacturers, manufacturers of coke and other products of the carbonisation of coal, and of coal briquettes or other patent fuel, chemical manufacturers, refiners, distillers, dye makers, gas makers and metallurgists, etc. A subscriber: H. Oakley, Gordon Lodge, South Bank, Surbiton.

New Chemical Trade Marks

Applications for Registration

This list has been specially compiled for us from official sources by Gee and Co., Patent and Trade Mark Agents, Staple House, 51 and 52, Chancery Lane, London, W.C.2, from whom further information may be obtained, and to whom we have arranged to refer any inquiries relating to Patents, Trade Marks, and Designs.

Opposition to the Registration of the following Trade Marks can be lodged up to July 26, 1929.

GLISKOL.

501,353. Class 1. Coal tar dyestuffs. I.G. Farbenindustrie Aktiengesellschaft (a joint stock company organised under the laws of Germany), Mainzer Landstrasse 28, Frankfurt-on-Main, Germany; manufacturers.—March 27, 1929. To be Associated with No. 501,354 (2,669). (By Consent.)

LEPTON.

501,355. Class 1. Coal tar dyestuffs. (Name and address as above.)—March 27, 1929.

LIVADEN.

502,955. Class 3. Chemical substances prepared for use in medicine and pharmacy. The British Drug Houses, Ltd., 16 to 30, Graham Street, City Road, London, N.1; wholesale druggists.—May 23, 1929.

FOUADIN.

503,040. Class 3. Chemical substances prepared for use in medicine and pharmacy. Bayer Products, Ltd., 31 to 34, Basinghall Street, London, E.C.2; merchants and manufacturers.—May 25, 1929.

"C.A." Queries

We receive so many inquiries from readers as to technical, industrial, and other points, that we have decided to make a selection for publication. In cases where the answers are of general interest, they will be published; in others, the answers will simply be passed on to the inquirers. Readers are invited to supply information on the subjects of the queries:—

• (131) *Etching of Celluloid*.—"We shall be glad to know whether you are able to put us in touch with anyone who can give us information regarding the process of etching of celluloid."

(132) *Armarine*.—An inquirer wishes to know the nature and manufacturers of Armarine, a cellulose substitute.

Chemical Trade Inquiries

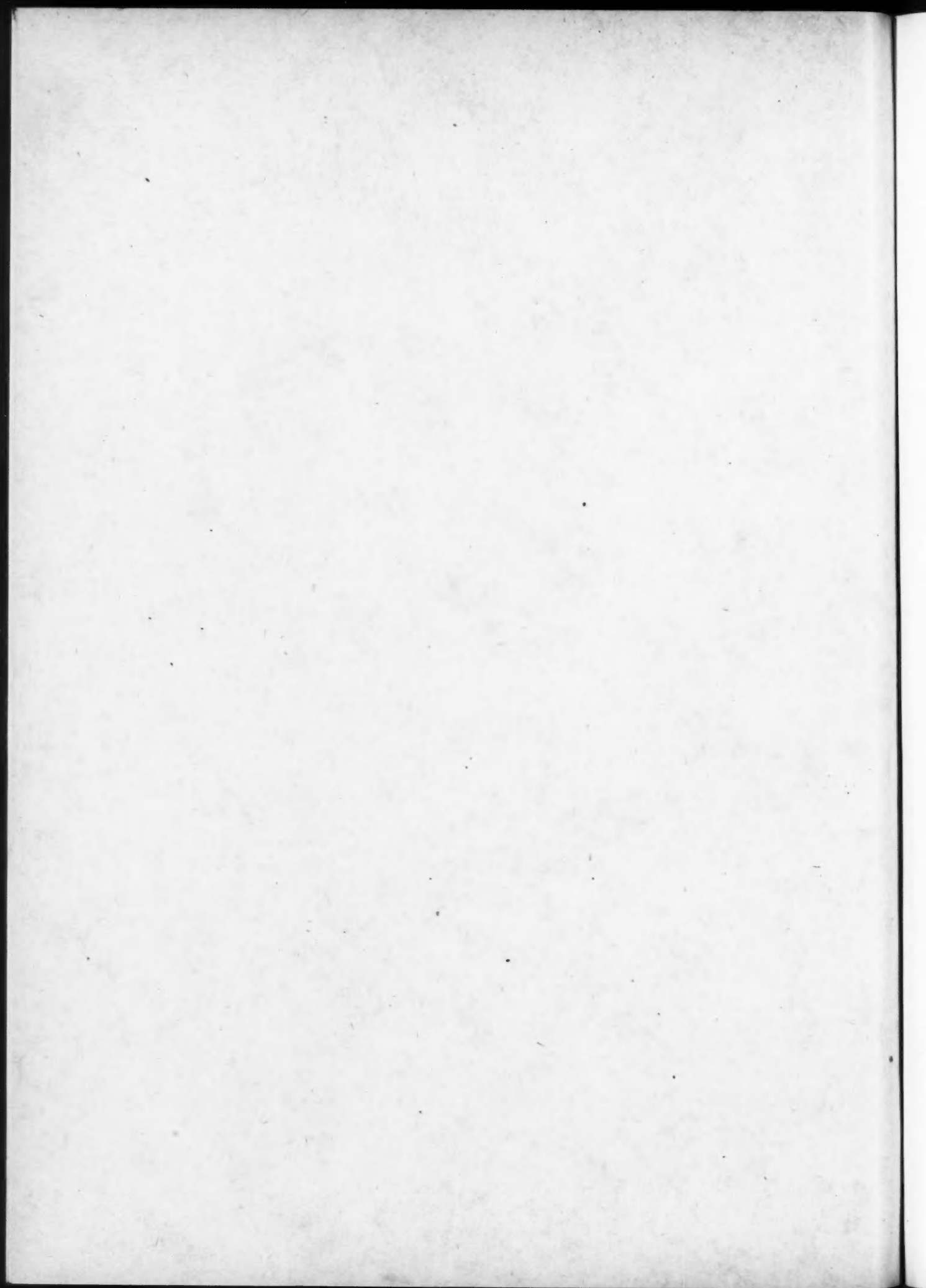
The following inquiries, abstracted from the "Board of Trade Journal," have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

CHEMICALS.—A firm in Montreal desire British agencies on a commission, purchase or consignment basis for Eastern Canada. (Reference No. 558.)

CHEMICAL PRODUCTS OF ALL KINDS.—An agent of good standing in Bilbao wishes to obtain the representation in Spain of British manufacturers or exporters. (Reference No. 568.)

Chilean Government to Erect Copper Foundry

THE CHILEAN GOVERNMENT is said to have the intention of erecting a copper foundry of large capacity. In order to retain a sufficiency of raw material, it is suggested that the *ad valorem* export tax on ores and concentrates will be raised to 30 per cent.



The China Clay Trade Review

The Official Organ of the China Clay Industry and the only Journal specially devoted to its interests.

PIONEERS IN GRAVEL AND SAND PUMPING

Pumps

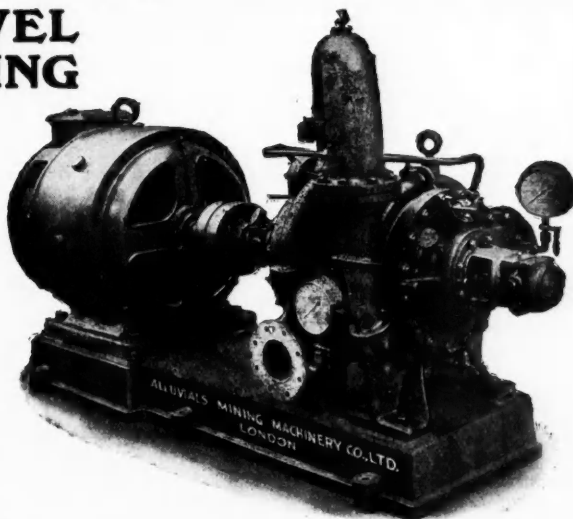
For Slime, Clay, Sand, Gravel,
Stone, Water, Pressure
ANY CAPACITY.

Types

SINGLE SERIES, LOW, MEDIUM AND
HIGH LIFT, SEPARATE LININGS,
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Slurry Pumps as supplied to Lansalson,
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Sole Agents in Devon & Cornwall for
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Newquay China Clay Co., Ltd., Newquay, Cornwall.
North Goonbarrow China Clay, Ltd., 3, Victoria Place, St. Austell.
Parkyn & Peters.
Pochin, H. D., & Co., Manchester.
Somerset Oxide and Ochre Co.
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The China Clay Trade Review

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China Clay Valuations

THANKS to the wide publicity given to the China Clay industry's protest against the depositing of old figures in the draft valuation list by the St. Austell Rural Authority, the authorities have been moving in the matter, and have elicited the following important pronouncement on the subject from the Ministry of Health. As it so intimately concerns the industry we give the letter—which was addressed to the St. Austell Rural District Council—in extenso.

Ministry of Health's Letter

"Rating and Valuation (Apportionment) Act, 1928.
Local Government Bill.

"I am directed by the Minister of Health to refer to your letter of the 26th ultimo, and to say that the Minister understands that the Council's valuer, Mr. Body, has been in communication with the secretary of the Central Valuation Committee as to the procedure to be adopted in the preparation of the Draft Special Lists to be made under the Rating and Valuation (Apportionment) Act in the case of China Clay hereditaments. . . . While the Minister is not empowered to express any authoritative opinion, he may say that he concurs generally with the advice given to Mr. Body by the Secretary of the Valuation Committee, and thinks that if this advice is followed no difficulty should arise.

"The Minister does not desire to offer specific comments on counsel's opinion which you enclose with your letter, though he does not at present advise accept the conclusions. With regard, however, to the suggested financial effects on the proposed grants to the County or District, I am to state that the Minister's intention is as follows: The figures of rateable value to be used for the purpose of calculating the loss of rates will be those appearing in the valuations lists in force on October 1, 1929, but if these figures are shown (as the result of the decision of an objection or appeal outstanding at that date or a proposal for amendment made between that date and March 31, 1930) to have been incorrect at that date, and are altered in the valuation lists in force of October 1, 1929, they will be adjusted retrospectively, and the adjusted figures will be used for the purpose of grant calculation.

Offer of a Conference

"The Minister fully appreciates the importance to local authorities of this point, and he is advised that the combined effect of the relevant statutory provisions and that of the Local Government Bill now before Parliament is to carry out that intention. I am, however, to assure you that the matter will receive further consideration, and if it appears that there is any doubt steps will be taken to remove it.

"You will probably wish to send a copy of this letter to the China Clay Association, and I am to add that, should you or they desire to confer with the officers of the Department on this matter, an appointment could be made at short notice."

Alarm Allayed

THE alarm felt throughout the China Clay district by the recent revelations made by Associated China Clays, Ltd., on behalf of the China Clay industry, to the effect that

unless the old figures in the recently deposited valuation list were brought up to date the rates stood to lose a considerable proportion of the grants that would be payable under the Government's new derating scheme, will be to some extent allayed by this letter.

Like most official Government communications, it is non-committal, but reading between the lines it is evident that the China Clay Association's representations to the rating bodies of the county, which have been brought to the Ministry's notice, have accomplished what was desired—they have made the Ministry's officials sit up and take notice. The nature of the communication made by the Rural Council's valuer (Mr. Body, of Plymouth) to the Central Valuation Committee in London has not been disclosed, but the resultant advice of that committee to Mr. Body, if followed, will, the Ministry thinks, obviate any difficulty arising.

The Time Limit for Revision

ON the question of the time limit for the inclusion of new valuations in the lists for the purposes of the Government's derating grants, the Ministry is more specific after questioning counsel's opinion, which was to the effect that if the new valuations were not in the lists to come into operation next April they could not be the basis of the grants to be made by the Ministry for the next five years. The Ministry's intention, says the letter, is that if the figures appearing in the list in force on October 1, 1929 (the date from which the grants will be payable), are proved to be incorrect they can be adjusted up to March 31, 1930, and whatever difference is disclosed between the original figures will be retrospectively adjusted. That, it should be emphasised, is the intention, and a good intention too, though that would not suffice to meet the objections that would have been raised if the Ministry did not go further and say "that the matter will receive further consideration, and if it appears that there is any doubt steps will be taken to remove it." Another point of interest is that the letter adds that should the St. Austell Rating Authority or the China Clay Association desire to confer with officers of the Department on the matter, an appointment could be made at short notice.

So far so good. Nevertheless it would be better for all concerned if the new valuations could be included, and finally appear in the list that will come in operation in October, when the derating grants start.

For this reason, everybody, and especially industry, prefers to know the best or worst about the rates when they are levied. The objections to retrospective adjustments, while they are better than no adjustments at all, are the uncertainty of the amount payable and the complications that will arise in the book-keeping and accountancy of industrial firms in consequence. Until such adjustments are made and agreed upon, they will not know exactly where they stand as regards their rates, a very unsatisfactory position.

While it looks as if the industry and the ratepayer generally will be safeguarded even if the new valuations are not included in the list to come into operation in April, an effort is being made to get the new valuations in, so as to obviate the necessity for the retrospective adjustments suggested.

Basic Industrial Minerals : No. III.—Graphite

By G. Malcolm Dyson, Ph.D., A.I.C.

HISTORICALLY, graphite is an exceedingly interesting mineral. It was known to the ancients, but was confused with several other minerals of a similar appearance, notably the sulphide of molybdenum known as molybdenite. A very interesting passage occurs in the *De rerum fossilum figuris* of Conrad Gessner (1565), in which it is clear that graphite was known and used for the manufacture of pencils at this period. The passage referred to relates to the sketch of a lead pencil, and runs:—"The pencil represented below, is made, for writing, of a certain kind of lead (which I am told is an artificial substance termed by some English antimony) sharpened to a point and inserted in a wooden handle."

It has been amply established that the earliest use of graphite was the manufacture of these pencils, to which the name "graphite" itself testifies. The alternative name "plumbago" does not appear to be connected with the place-name, but to be derived from the Italian "grafio piombino."

Occurrence

Deposits of graphite are widely distributed throughout the older crystalline rocks, such as granite, gneiss and slate, and appear to have been produced by subsequent position into already existent fissures. The value of such deposits depends entirely on the physical characteristics of the mineral; it is not possible to consider graphite as a definite chemical individual and to grade the deposits according to the percentage of carbon which they contain.

In this country graphite has been worked from the celebrated Borrowdale deposits in Cumberland. This mine was opened in the reign of Elizabeth, and although only worked for a few weeks in the year (for fear of overstocking the market) yielded a revenue of £40,000 annually; at the present time the veins of graphite are exhausted, and the only product is the green slate in which the graphite was formerly found. The graphite of Ceylon is usually considered to be the most valuable for the manufacture of crucibles, etc., and comparative tests will be discussed below. In addition there are extensive deposits in Canada, Madagascar, Alabama, Montana and Texas, of which the Madagascan deposits are held to be the best.

Although not of paramount commercial importance, there are several methods of obtaining graphite artificially which are not without interest. When carbon is dissolved in molten cast iron and the solution allowed to cool, the carbon crystallises out in a definite graphite form (known to the foundrymen as "kish"). This fact was first observed by Scheele in 1778, i.e., in the year previous to his well-known differentiation between graphite and molybdenite. In addition, a certain amount of graphite is produced in the Black Ash process. The black ash liquors, after evaporation, are oxidised by the addition of sodium nitrate, when the graphite rises to the surface as a scum.

Extraction

The raw material from the mines does not usually contain more than 50–70 per cent. of graphite, the impurities being principally mica, quartz and siliceous matters. The latter are especially to be avoided in the final product when destined for use in the manufacture of lubricants, although the presence, under these circumstances, of a small amount of mica is not a serious disadvantage.

Preparation for the market is purely mechanical. The raw material is first washed to get rid of earthy matters (a process carried out, for convenience on barbacues or sloping floors) and then sorted by hand. The large and apparently sound lumps are placed on one side and polished and packed separately. The smaller and imperfect lumps are smashed with a wooden mallet and after a second sorting are screened and graded, a form of differential air flotation being used to separate the non-graphitic impurities. Five main sizes are recognised commercially: large lumps, ordinary lumps, chips, dust and flying dust (X, XB, B, BE, and P.). There are, of course, numerous qualities, and the commercial examination of graphite is a difficult matter. The percentage of carbon is only a rough guide as to quality, whilst an examination of the ash will reveal the presence of abrasive impurities; the final judgment rests on the general physical properties.

Properties

The crystalline form of graphite is not certain; according to most authorities it belongs to the hexagonal system, but it has been classed as monosymmetric by Nordenskjöld. The X-ray structure of graphite raises an interesting problem, namely, that of the exact chemical nature of the substance. It appears that natural graphite always contains about 1–2 per cent. of hydrogen, and the hypothesis has been put forward that graphite is of organic origin obtained by the progressive

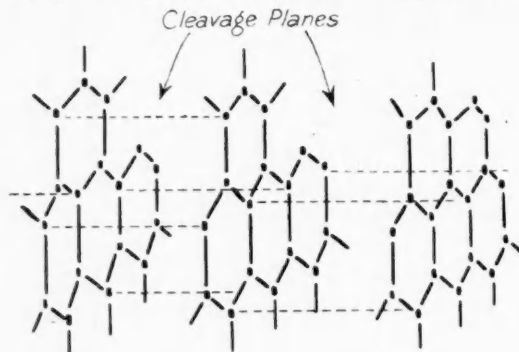


FIG. 1.—X-RAY DIAGRAM OF GRAPHITE.

dehydrogenation of aromatic hydrocarbons and that in the structure of graphite the aromatic ring remains intact. This is in some slight way confirmed by the fact that Brodie was able to oxidise graphite to graphitic acid, a substance of unknown constitution, but of the empirical formula $C_{11}H_2O_4$. When, however, graphite is examined by the X-ray method, it is found that the arrangement of particles (see Fig. 1) is in the form of a hexagonal space lattice, the hexagons being orientated in a series of parallel planes. Even a cursory inspection of the diagram will show that along certain planes the resistance to shearing forces will be extremely small—a fact which is not only in accordance with its use as a lubricant, but also with the fact that the foliated forms of graphite are more effective for this purpose than the granular forms, in which the particle orientation is not so polarised.

Uses

The uses of graphite may be classified as follows:—

Lubricants: Graphite powder, graphite greases and colloidal graphite.

Crucible Manufacture: For the melting of steel, especially tool-steel, and also of non-ferrous metals.

Miscellaneous: Polishing materials, foundry facings and electrical purposes.

As a lubricant, graphite has the advantages of standing up to extremely heavy wear, of being unaffected by heating of bearings, of being unalterable by oxidation, and of persisting longer than any other lubricant without renewal. There are two main methods by which graphite may be prepared for lubrication: it may be reduced to the colloidal state as in the Acheson process and then incorporated into oily or aqueous media, or the powdered graphite may be incorporated in some form of grease. For the latter purpose various types of medium are used. For slow moving parts (e.g., fulcrum bearings), a mixture of 70 parts of graphite with 12 of a medium paraffin wax has been found to give almost universal satisfaction; the corresponding mixture with soap in place of the wax has been used to a considerable extent, but has the disadvantage of washing out comparatively rapidly if the bearings are exposed to weather. For fairly quickly moving sliding parts, a mixture of tallow and graphite is often used, but the increase in acid value of such a mixture during use render the risk of corrosion quite a real problem. The average graphite grease that is marketed at the present time contains about 5–8 per cent. of graphite, together with 50–60 per cent. of heavy petroleum jelly, with the addition of lime soap and a small amount of a fatty oil. This type of mix can be very

materially improved by the substitution of a heavy vacuum oil for the petroleum jelly.

Little need be said about the use of graphite for polishing and pencil manufacturing purposes, save that freedom from grit is an essential quality for the latter operation. The application of graphite to foundry facings is a more complex matter; a good facing must be made from a heavy tenacious graphite (such as that from Ceylon); lighter varieties are washed off the surface of the mould by the flow of metal, with the result that the metal becomes burnt to the sand in patches, leading either to the rejection of the casting or to the necessity for prolonged cleaning.

Crucibles

The bulk of the graphite which comes into commerce is used in the manufacture of crucibles for steel melting, and to some extent for the production of crucibles for the manufacture of zinc oxide. In the latter case the crucibles are about three feet high and 20-24 inches wide at the mouth. Crucibles for this type of work last a considerable time, but in the steel-melting industry the life of the pot is fairly short, and is a considerable item in the cost of steel production. Attempts are constantly being made to improve the length of the life of the pot, but the difficulty lies in the fact that the life depends on the nature of the graphite used. Until quite

recently, Ceylonese graphite was almost exclusively used, but American investigations (see *Bureau of Mines Report No. 2512*) have indicated that certain of the American graphites can be made to give quite good results. A short account of the experiments may be of interest. The mixture for the pots contained 50 per cent. of the graphite to be tested, 27 parts of Missouri pot clay (washed), 13 parts of Kentucky ball clay and 10 parts of sand. Pots were made up to No. 60 size, burned at 700° C., and used for the melting of tool steel in a producer gas-fired furnace. The charge was 100 lb. of metal, and the pots were recharged immediately after pouring until they had to be withdrawn from service. The data below gives the results obtained (see also *Bureau of Mines Report No. 2512*):—

GRAPHITE.	AVERAGE NO. OF HEATS.	AVERAGE TIME OF HEATS. 3½ hours	CAUSE OF FAILURE.
Texas	7·67	3·5	Deeply cut at washline.
Alabama	7·10	3·5	Scaling, and thin.
Ceylon	7·0	3·7	Scaling, and thin.
Madagascar	7·0	3·7	Too thin to carry.
New York	6·0	3·6	Too thin and weak.
Canadian	1·0	4·2	Slagged away.
Montana	1·0	4·2	Cracks opened up.

From the above data there appears little to choose between the first four types of graphite for the purpose indicated.

The Secret of Cheap Production

Views of Mr. T. B. Johnson

In the Safeguarding Supplement published by "The Daily Telegraph" recently, Mr. T. B. Johnson, of the British Pottery Manufacturers' Federation, contributed an article on "The Triple Secret of Cheap Production." Coming from such a source, this article (the more important points in which are given below) should be of great interest to the China Clay industry.

LONGER ago than I care to remember (says Mr. Johnson) I was a witness before Mr. Chamberlain's Tariff Commission. I there enunciated an economic principle which, it seems to me, holds utterly true to this day. It was hardly a novel principle, inasmuch as it has always been recognised by the saner minds in British industry, but I was interested to see it fairly recently quoted textually in a report of a trade inquiry made by the American Government. "The great factor of cheap production in modern industry," I then asserted, in opposition to the view the Cobdenites had so long emphatically preached, "is no longer cheap labour and cheap materials, but quantity of output, coupled with the efficient use of up-to-date labour-saving appliances."

Mass Production

Unfortunately, in this country we find the dice loaded against this vital need of quantity of output. It means, to begin with, mass production, and for that three things are imperative. There must be command of almost unlimited capital; there must be a large and secure home market; and there must be an outside market in which, following our competitors' methods at our expense, we can dump our surplus output. In very few British industries do these conditions apply. There is certainly no very ready flow of capital. A great advantage of a tariff is that, by securing a home market and creating a sense of confidence, it attracts capital into a country, and that leads ultimately to cheaper production. There is no home market that is in real truth our own.

The American manufacturer, himself protected by high tariffs, has a market of over 100 millions in America, and also the 40-million free market of Britain. The German manufacturer adds to his own 60-million protected market the same 40-million free market of Britain.

Dumping

Unfortunately, we have no weapon with which to retort on the dumper. Perhaps it would be truer to say that our strange fiscal obsessions prevent us from bringing a very effective weapon into play. Meanwhile the foreign producer has got himself comfortably settled on our own doorstep. Further than that, and much less politely, he has been flinging us neck and crop, as it were, out of overseas markets in which for long we have had pre-eminence.

Now a big output, as I have said, is the real secret of cheap production, and in this respect our rivals are certainly going on the right lines. All we can say is that it is rather foolish of us to help them by giving them a free run of our markets. But that they should beat us simply through the debased

standards of living suffered by their workpeople is obviously all wrong. Clearly it is a matter that cuts directly at the welfare and prosperity of our own people.

I am connected with the pottery industry, and it is one that offers a remarkable example of the resourcefulness, not to say the relentlessness, of our competitors. Since the war the china section of our trade had been suffering severely because of cheap imports, but since the imposition of the safeguarding duty, granted only after a searching inquiry, those imports have virtually stopped. Scarcely had this occurred, however, than foreign earthenware, hitherto a fairly negligible import, began to pour into the country, unhampered by any duty.

Foreign Markets

German, Czechoslovakian, French, and Dutch earthenware makers can undersell us in our own market by 30 to 40 per cent. Further, we have information that they are capturing the very considerable trade we had in countries like India, Australia and South Africa. They can undercut us by anything from 25 to 40 per cent., and they can do it, of course, through their low wages. If we could secure our home market, as we could by a safeguarding duty, we should be in a better position to fight them in the foreign market, but as matters stand we are suffering from a hopeless double handicap.

One point I have not yet seen brought forward in this discussion. The Government, by reason of the 4s. in the £ income-tax, is now a partner in all our businesses to the extent of one-fifth of our profits. Upon goods coming from abroad the merchant can make a net profit of about 2½ per cent. on his turnover. If £100,000 worth came in, therefore, the Government would receive one-fifth of only £2,500 by way of income-tax, and very little in the same form from the merchant's staff, which would be very small. Now, if that £100,000 worth, instead of coming in from abroad, had been manufactured in a pottery in this country, and we made a 10 per cent. profit, which we should do (because in the pottery trade the capital is equal to the turnover), the Government would receive from the firm in income-tax no less than £2,000.

Further, the pottery that displaced the imported goods would require coal, clay, bricks, stilts, spurs, and other material, all of which would be produced in this country, and all of which would involve incomes on which tax would have to be paid. Employment given to British labour, again, would mean more in the form of wages being spent on coal, boots and shoes, clothing and furniture, and all the other necessities of life, and on all these income-tax would also have to be paid.

China Clay Notes and News

Production of Silica Brick in Canada

THE Dominion Bureau of Statistics at Ottawa reports that, according to finally revised data, the production of silica bricks in Canada during 1927 amounted to 1,791 thousand with a valuation of \$79,527; in the previous year 2,665 thousand, valued at \$130,702, were produced.

Pulverised Coal Experiments

Interesting developments are taking place in connection with the drying of clay. Experiments are being carried out by Beacon Clays, Ltd., under the managing directorship of Mr. E. J. Hancock, at their new kiln at High Street Siding, Burngullow. A coal pulverising plant has been installed, and clay is being dried by pulverised fuel. This is the first plant of its kind to be installed in China Clay production, and the fuel can also be used for raising steam for power purposes at a low cost.

Lovering and Co.'s Deal

The contract for the sale of John Lovering and Co.'s China Clay business, which was on the eve of completion to Sir Charles Cottier's syndicate when Sir Charles died, has been signed and the deposit paid. The principals mainly concerned in the purchase are Balfour, Williamson and Co., the Liverpool shipping firm, whose association with the China Clay trade up to now has been chiefly in the capacity of shippers of China Clay, mainly to America. Mr. E. J. Hancock, of the West Carclaze and other companies, whose family is connected through the Martins with Lovering and Co., has been the chief intermediary in carrying through the deal. The purchase price is stated to be £500,000.

Pottery Trade and Safeguarding

It is stated by the *Daily Telegraph* that an application is about to be lodged with the Board of Trade by the British Pottery Manufacturers' Federation for a safeguarding duty on general earthenware. The classes involved are table ware and other articles commonly used in connection with the serving of food and drink, toilet, and hospital ware. It is hoped that, in the event of the Board of Trade finding that a *prima facie* case has been made out, a committee of inquiry will be appointed without delay, so that an import duty, if recommended, can be included in the next Budget. The general earthenware section employs between 30,000 and 35,000 workers, or about half the total engaged in the industry.

An M.P. on Derating

Referring at a meeting of some of his constituents at St. Dennis on Wednesday, to the benefits of the Governments derating scheme, Mr. George Pilcher, M.P. for the Penryn-Falmouth Division, said the clay industry would receive benefits of between £60,000 and £80,000.

Prosperity in the Cornish clay field, particularly in regard to second-class clays, depended upon the last sixpence or shilling in the cost of production in competition with clays from other countries, particularly the United States. Every penny in these competitive prices counted, and if more capital could be put into the hands of the owners of pits it would result in more work for the men and greater development in the seams by the removal of overburden.

Inauguration of Clay Workers' Union

At meetings recently held relative to the amalgamation of the Workers' Union with the Transport Workers' Union the scheme has been explained. Mr. Joe Harris, of the Workers' Union, said it had been his lot to have been during many years in the China Clay area, and he could sincerely say that never had he taken part in a meeting which had given him greater pleasure than that one. He had been for 38 years an active member of a trade union, he had worked with others to lift, by organisation, the worker who was lowly paid and had to work long hours, to better conditions. He had seen great strides in the time he had mentioned. He had always looked forward to the time when workers of this and all countries would be united in one union with officials at the head of it whom the members would trust and support. He had heard

clay workers in Cornwall on more than one occasion say there were too many unions, let them have one union.

Mr. Beard's Remarks

Mr. Beard, president of the Workers' Union, referred to the time when he came to Cornwall during the dispute of 1913, which he considered was the beginning of the modern trade union movement in the county. They did not actually win them, but out of that came the winnings. Men asked what the union had done for them. Non-unionists, who usually possessed a certain amount of impudence, threw out that challenge.

They knew what union had done for the men in Cornwall. Conditions were different now from what they were in 1913. That was only due to the fight they put up then, which did immense credit to at least half the people who worked in and among the clay-works.

Since the war, said Mr. Beard, the trade unionists had been grumbling at each other, and the capitalist had been making all he could out of it. In some ways it was no wonder that they had saved so much. But there had been no increase in the hours of labour. Wages had been reduced somewhat, but had only followed the cost of living basis. The conditions of the clay workers from 1913 to now had been immensely improved, and that was due to the trade unions.

Under the amalgamation, the clay workers would have their own council, would do their own business under the guidance of officials, and would make their own arrangements with the employers. Men who loaded the clay would be in the same union as the men who got the clay. It would be a much more simple position than it was before.

China Clay Possibilities

There is a great scope for the encouragement of a very much larger volume of trade in China Clay sand. The chief factor operating against the disposal of a larger quantity is undoubtedly the fact of the increased production of foreign clays of the commoner grades, which is seriously affecting the overseas demand for our home-produced common clays. Touching on this aspect of the question, Mr. R. Grosvenor Varcoe, of Varcoes China Clays, Ltd., sends a letter setting out his views on the future prospects for common clays:

"It is common knowledge," says Mr. Varcoe, "that the market for cheap or common China Clay in Cornwall is diminishing year by year, and the future outlook for firms producing this class of clay is far from cheerful. The reason for this is easy to understand when one looks into the foreign production of this class of clay, which is gradually killing the Cornish production of these cheap clays."

"The production of China Clay in foreign countries is now approximately 500,000 tons against approximately 50,000 tons pre-war. It is thus easy to see how the Cornish cheap clay producers are suffering through these comparatively new competitors. These Cornish works are well equipped, and years of hard work and thought has been put into them. The question arises: How can these works be put on to a footing by which they can compete with the foreigner? Does it seem right that one of Cornwall's oldest industries should fade away, without a united effort to assist in combating this competition? Here are a few suggestions which may, or may not, be practicable."

"Could the landlord of these common China Clay works temporarily reduce the dues? Could the railway give a differential rate to these China Clay producers? Could the coal merchants give a slightly easier price? Could a special reduced rate or levy be charged by an association, if any? Could a broker give a little easier freight? Could the merchant who purchases this class of clay pay cash against invoice to any of these cheap producers, for clay shipped to any foreign port? Could the worker give an extra half-hour (gratis) each day till the position is relieved?"

"If some of the above suggestions could be effected, they might be the means of enabling these firms to fight the foreigners better, and incidentally to bring more work to the China Clay worker, who is suffering (through no fault of his own) from slackness of work, owing to the above-mentioned foreign competition."

Shipping and Export News of the Month

We give herewith latest particulars relating to arrivals and sailings of ships engaged in the China Clay trade, at the principal British clay ports. Registered exports of China Clay, with countries of destination, and other shipping and export matters are dealt with.

Fowey Shipping—December, 1928

Arrived.	Name.	Sailed.	Destination.
December 1, s.s.	<i>St. Barchan</i>	December 6,	Gravesend
December 1, s.s.	<i>Ebbrix</i>	December 5,	Gravesend
December 2, s.s.	<i>Sarnia</i>	December 5,	Pasages
December 2, s.s.	<i>Vechtstroom</i>	December 5,	Amsterdam
December 4, s.s.	<i>Oak</i>	December 8,	Liverpool
December 4, s.s.	<i>Porthcarrack</i> ...	December 6,	Harburg
December 4, s.s.	<i>Horsham</i>	December 7,	Antwerp
December 4, s.s.	<i>Glenconway</i>	December 7,	Liverpool
December 5, s.s.	<i>Ida</i>	December 8,	Antwerp
December 5, s.s.	<i>Foch Rose</i>	December 7,	Preston
December 5, s.s.	<i>Gouwestroom</i> ...	December 7,	Amsterdam
December 6, s.s.	<i>Cisneros</i>	December 8,	Genoa
December 7, s.s.	<i>Burrington Combe</i>	December 8,	Bristol
December 7, s.s.	<i>Manchester</i>	December 14,	Portland, Me.

Shipper

December 8, s.s.	<i>Fowey Rose</i>	December 14,	Ridham
December 8, s.s.	<i>Joffre Rose</i>	December 14,	Rouen
December 8, s.s.	<i>Farfield</i>	December 13,	Grimsby
December 9, s.s.	<i>Gronant Rose</i> ...	December 12,	Rouen
December 9, s.s.	<i>Brier Rose</i>	December 14,	Runcorn
December 9, s.s.	<i>Lina L.D.</i>	December 19,	San Francisco
December 10, s.s.	<i>Queenie</i>	December 11,	Par
December 11, s.s.	<i>Vechtstroom</i>	December 13,	Amsterdam
December 11, s.s.	<i>Gunver</i>	December 15,	Genoa
December 11, s.s.	<i>Primrose</i>	December 14,	Leith
December 12, s.s.	<i>Ardgarrock</i>	December 15,	Antwerp
December 12, s.s.	<i>Tanny</i>	December 15,	Plymouth
December 13, s.s.	<i>Fermaine</i>	December 18,	Pasages
December 13, s.v.	<i>Les Jumelles</i> ...	December 20,	Rochefort
December 13, s.s.	<i>Guelder Rose</i> ...	December 17,	Preston
December 14, M.V.	<i>Doris</i>	December 20,	Stettin
December 14, s.s.	<i>Glencregagh</i>	December 18,	Garston
December 14, s.s.	<i>Magrix</i>	December 17,	Par
December 14, s.s.	<i>Gouwestroom</i> ...	December 19,	Amsterdam
December 15, s.s.	<i>Levenbridge</i>	December 22,	Philadelphia
December 15, s.s.	<i>Jarrix</i>	December 19,	Antwerp
December 15, s.s.	<i>Knowle Grove</i> ...	December 19,	Gravesend
December 15, s.s.	<i>Goodig</i>	December 19,	Antwerp
December 15, s.v.	<i>Lady Daphne</i> ...	December 18,	Pentewan
December 16, s.v.	<i>Galathea</i>	December 28,	Par
December 17, s.s.	<i>Golfer</i>	December 20,	Tayport
December 17, s.s.	<i>Newton Beach</i> ...	December 29,	Bombay
December 18, s.s.	<i>Foch Rose</i>	December 22,	Ghent and

Brussels

December 18, s.s.	<i>Mersey</i>	December 22,	Rouen
December 18, s.v.	<i>My Lady</i>	December 24,	Hull
December 18, s.s.	<i>Gronant Rose</i> ...	December 24,	Preston
December 19, s.s.	<i>Blush Rose</i>	December 28,	Weston Pt.
December 19, s.s.	<i>Overton</i>	December 22,	Liverpool
December 20, M.S.	<i>Johanne Margrethe</i>	December 27,	Harburg
December 20, s.s.	<i>Vechtstroom</i>	December 28,	Amsterdam
December 20, M.V.	<i>Mars</i>	December 27,	Harburg
December 21, s.s.	<i>Boston City</i> ...	January 2,	Portland, Me.
December 22, s.s.	<i>Sturdee Rose</i> ...	*	Rouen
December 21, s.s.	<i>Joffre Rose</i>	December 31,	Weston Pt.
December 22, s.s.	<i>Inga</i>	January 2,	Oscarshamm
December 22, s.s.	<i>Pansy</i>	December 28,	Leith
December 22, s.v.	<i>Pallesen</i>	December 28,	Charlestown
December 22, s.s.	<i>Ida</i>	December 31,	Antwerp
December 22, s.v.	<i>Garibaldi</i>	*	Flensburg
December 22, s.s.	<i>Beaunray</i>	December 31,	Leith
December 22, s.s.	<i>Manchester</i>	*	Portland, Me.

Civilian

December 23, s.s.	<i>Nedjan</i>	January 3,	Drammen
December 23, s.s.	<i>Brier Rose</i>	December 29,	Fleetwood
December 23, s.s.	<i>Cornish Rose</i> ...	*	Weston Pt.
December 23, s.s.	<i>Herfenn</i>	*	Skien
December 23, s.s.	<i>Greenawn</i>	*	Antwerp
December 23, s.s.	<i>Teesbridge</i>	*	Philadelphia
December 24, s.s.	<i>Hayle</i>	*	Weston Pt.
December 25, s.s.	<i>Haig Rose</i>	*	Brussels
December 30, s.s.	<i>Gouwestroom</i> ...	*	Amsterdam
December 30, s.s.	<i>Guelder Rose</i> ...	*	Rouen
December 31, s.s.	<i>Fowey Rose</i>	*	Ridham
December 31, s.s.	<i>Dorrien Rose</i> ...	*	Antwerp
December 31, s.s.	<i>Margaret</i>	January 3,	Charlestown
December 31, s.s.	<i>Farfield</i>	*	Grimsby
December 31, s.s.	<i>Cambalu</i>	*	Liverpool

* Signifies "In Port."

Par Harbour Shipping—December, 1928

Date.	Vessel.	Destination.
December 1, s.s.	<i>Bangor</i>	Sunderland
December 1, s.s.	<i>Grosvenor</i>	Lancaster
December 1, s.s.	<i>Christina</i>	Falmouth
December 2, s.s.	<i>Treleigh</i>	Preston
December 4, s.s.	<i>Freighter</i>	London
December 4, s.s.	<i>Robrix</i>	London
December 4, M.V.	<i>Rottum</i>	Rochester
December 8, M.V.	<i>Frida Both</i>	Antwerp
December 12, s.v.	<i>Lady Agnes</i>	London
December 15, s.s.	<i>Queenie</i>	Runcorn
December 15, s.s.	<i>Jarrix</i>	Fowey
December 17, s.s.	<i>Golfer</i>	Fowey
December 17, s.s.	<i>Clyde Firth</i>	Charlestown
December 17, s.s.	<i>Magrix</i>	Charlestown
December 19, s.s.	<i>Goole</i>	London
December 23, s.s.	<i>Freighter</i>	Gravesend
December 24, s.v.	<i>Lady Daphne</i>	Fowey
December 31, s.s.	<i>Freighter</i>	Gravesend

Charlestown Shipping—December, 1928

Arrived.	Vessel.	From	Sailed.	Destination.
November 29, s.v.	<i>Lady Roseberry</i>	Weymouth	December 3,	Rochester
December 1, s.s.	<i>Clyde Firth</i>	Truro	December 1,	London
December 4, s.v.	<i>Flying Foam</i>	Plymouth	December 18,	London
December 8, s.v.	<i>S. F. Pearce</i>	Penryn	December 17,	Rochester
December 12, s.s.	<i>Porthmear</i>	Port Talbot	December 15,	Aberdeen
December 17, s.s.	<i>Clyde Firth</i>	Par	December 18,	Rochester
December 17, s.s.	<i>Magrix</i>	Par	December 19,	Gravesend
December 21, s.v.	<i>Englishman</i>	Falmouth	December 28,	Runcorn
December 22, s.v.	<i>Hans Johann</i>	Falmouth	December 28,	Granton
December 22, s.s.	<i>Telf</i>	Barry	December 24,	Barrow
December 29, s.s.	<i>Treleigh</i>	Portreath	December 29,	Preston

China Clay Exports, December 1928

A RETURN showing the quantity and value of the exports of China Clay, including Cornish or China Stone, the produce of Great Britain and Northern Ireland, from Great Britain and Northern Ireland, as registered in the month of December, 1928, is as follows:—

COUNTRY OF DESTINATION.	Quantity. Tons.	Value. £
Sweden	560	1,279
Denmark	2	21
Germany	3,730	7,816
Netherlands	3,790	8,460
Belgium	4,233	7,900
France	2,548	4,851
Madeira	—	4
Spain	1,567	4,995
Italy	2,583	6,264
Japan	115	560
United States of America	16,203	38,220
Chile	10	49
Cape of Good Hope	38	65
Natal	—	5
Orange Free State	1	4
Bombay, via Other Ports	2,169	7,433
Madras	15	112
Bengal	335	999
Australia	34	241
New Zealand	2	18
Canada	47	453
Irish Free State	9	30
Total	37,991	89,695

China Clay Imports, December 1928

A RETURN showing the quantities and value of China Clay (including China Stone) imported into Great Britain and Northern Ireland as registered in the month of December, 1928, is as follows:—

COUNTRIES WHENCE CONSIGNEE.	QUANTITIES. Tons.	VALUE. £
Germany	2	24
U.S. America	25	150
Total	27	174

December Deliveries

As was to be expected, last month's deliveries, interrupted by the holidays, were down by about 9,000 tons from November deliveries. After crediting 60,000 tons, delivered in the closing months of 1927, to 1928 account, the estimated quantity taken by buyers in anticipation of the Association's inauguration, the adverse balance against 1928 was over 40,000 tons, compared with 1927. Details:—

PORT.	CHINA CLAY.		CHINA STONE.		BALL CLAY.		TOTAL.	
	Tons.	1928.	Tons.	1927.	Tons.	1928.	Tons.	1927.
Falmouth	150	1,156	—	—	—	—	150	1,156
Fowey	60,083	67,159	2,647	2,924	1,233	995	63,963	71,438
Par	3,113	5,485	—	—	—	—	3,113	5,485
Penzance	1,015	—	—	—	—	—	1,015	—
Plymouth	2,532	3,170	—	—	—	—	2,532	3,170
Charlestown	2,798	5,064	—	—	—	—	2,798	5,064
By rail	3,692	5,028	—	—	—	—	3,692	5,028
Total for Decem- ber	73,383	87,422	2,647	2,926	1,233	995	77,263	91,341
Total for 11 months	744,381	832,652	45,466	51,627	23,940	21,669	813,785	905,928
Total for 12 months	817,764	920,074	48,113	54,551	25,173	22,664	891,048	997,269

Standard Zettlitz Kaolin Test

Results of Work by U.S. Bureau of Standards

At its Copenhagen meeting, the International Union of Pure and Applied Chemistry voted to undertake the preparation and distribution of an international standard sample of Zettlitz kaolin, and charged the Ceramic Society of Czechoslovakia with the duty of carrying out this resolution. This society established a permanent committee to prepare, distribute, and to act as custodian for this standard sample. Samples of this standard may be secured by application to The Ceramic Society of Czechoslovakia, Prague, Czechoslovakia. Samples of this standard have been distributed to the countries belonging to the Union for analysis and test, and it is hoped that a comparative study of the results obtained will lead eventually to the adoption of international methods for the analysis and testing of clays for ceramic purposes.

The report given herewith contains the results obtained in the study of the standard kaolin at the Bureau of Standards, made in accordance with the methods adopted by the American Ceramic Society and also other methods in use at the Bureau.

Chemical and Physical Examination

COMPONENT.	Per cent.
Silica (SiO ₂)	46.90
Alumina (Al ₂ O ₃)	37.40
Ferric oxide (Fe ₂ O ₃)	0.65
Phosphorous pentoxide (P ₂ O ₅)	0.08
Titania (TiO ₂)	0.18
Zirconia (ZrO ₂)	0.007
Manganese oxide (MnO)	0.007
Calcium oxide (CaO)	0.29
Magnesium oxide (MgO)	0.27
Barium oxide (BaO)	0.02
Strontium oxide (SrO)	0.006
Chromic oxide (Cr ₂ O ₃)	0.015
Vanadium trioxide (V ₂ O ₃)	0.002
Potassium oxide (K ₂ O)	0.84
Sodium oxide (Na ₂ O)	0.44
Sulphur trioxide (SO ₃)	0.03
Loss on ignition (1050-1100° C.)	12.95
Total	100.087

SUMMATION OF PHYSICAL TESTS.

Test.	Clay.	50/50 Clay- Flint Mix.
Softening point.	Above cone 34 (1755° C.)	
True specific gravity	2.633	
Dry volume shrinkage.	25.8 per cent.	16.1 per cent.
Dry linear shrinkage.	7.9 " "	5.1 " "
Water of plasticity.	46.4 " "	29.8 " "
Shrinkage water.	17.1 " "	10.4 " "
Pore water.	29.3 " "	19.4 " "
Dry transverse strength.	261 lbs./sq. in.	116 lbs./sq. in.

In the determination of the firing behaviour, values were obtained on specimens of clay and of 50/50 clay-flint mixtures fired to cones 2, 4, 6, 8, 10, 12, 14, 16, and 18. Only the results at cone 12 are reported herewith.

Test.	FIRING BEHAVIOUR.	
	Clay.	50/50 Clay- Flint.
Porosity	25.4 per cent.	32.0 per cent.
Fired volume change.	33.35 " "	8.75 " "
Linear change.	12.75 " "	3.35 " "
Apparent specific gravity	2.545	2.555
Bulk specific gravity	1.90	1.75
Absorption	12.9 per cent.	17.5 per cent.
Fired transverse strength.	4,290 lbs./sq. in.	1,660 lbs./sq. in.
Modulus of elasticity	5,911,000 lbs./sq. in.	
Coefficient of expansion per degree Centigrade (Interferometer method) 6.74 × 10 ⁻⁶		12.94 × 10 ⁻⁶

St Austell Clay Firm's Action

Judgment at Plymouth

At Plymouth County Court, on Monday, January 14, His Honour Judge Gurdon gave judgment in the action reported in our last issue, in which Grose and Stocker, China Clay merchants, St. Austell and Stoke-on-Trent, sued Mr. Albert Westcott, shipbroker, of Plymouth, in respect of £109, the claim arising out of an alleged breach of charter party. His Honour, reviewing the case, said he was not of opinion that at the time the charter party was made defendant had reasonable grounds for expecting the ship to be ready at Par for loading on the date stated. In his opinion the shipbrokers were defendant's agents for negotiating as well as signing the charter party. There was no evidence of any limitation of the shipbrokers as his agents.

Three defences put forward were that the damages claimed were too remote; as to the form of contract; and that the printed charter party contained a clause which defendant took to mean that he had three weeks in which to repair the vessel. These all failed.

It was also objected that plaintiffs were premature in sending three consignments by steamer to prevent their stocks of clay at Sunderland running short, as there was no certainty that the paper company would have taken action against plaintiffs even if they had been behind in carrying out their contract. His Honour considered the first two consignments were fully justified by plaintiffs, but the third consignment stood on a different footing and seemed to have been sent by plaintiffs through over-caution. This claim failed, but the claim in respect of the first two consignments stood. Judgment was for £72 15s. 4d. with costs.

Mr. Mayburne Pearce, for defendant, asked for stay of execution, and His Honour agreed. Plaintiffs were represented by Mr. S. Carlile Davis.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

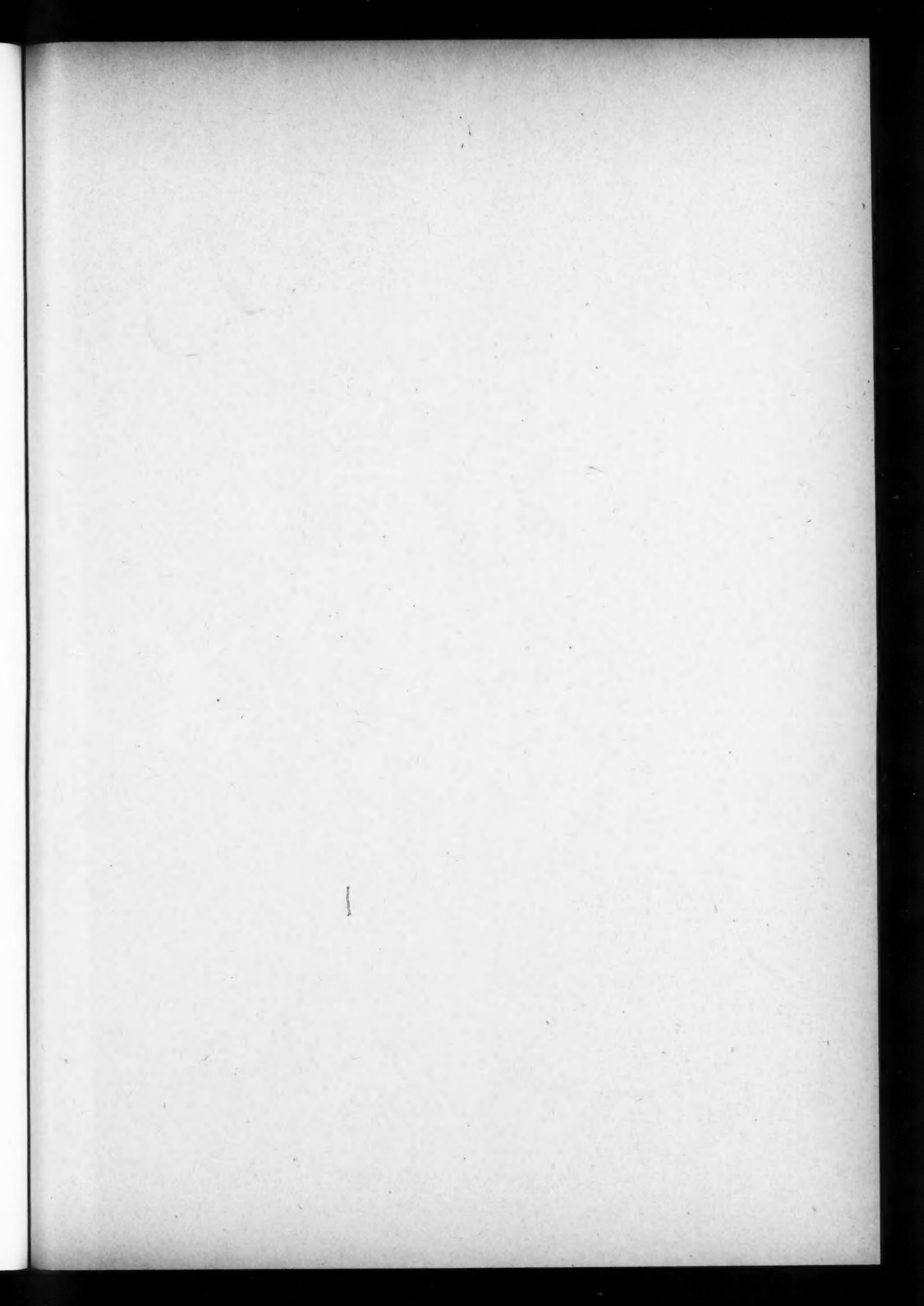
ALDERS PAPER MILLS, LTD., Tamworth. Registered December 20, £35,000 debentures (secured by Trust Deed dated December 10, 1928), charged on properties at Wigginton, etc., also general charge. *£28,000. December 31, 1927.

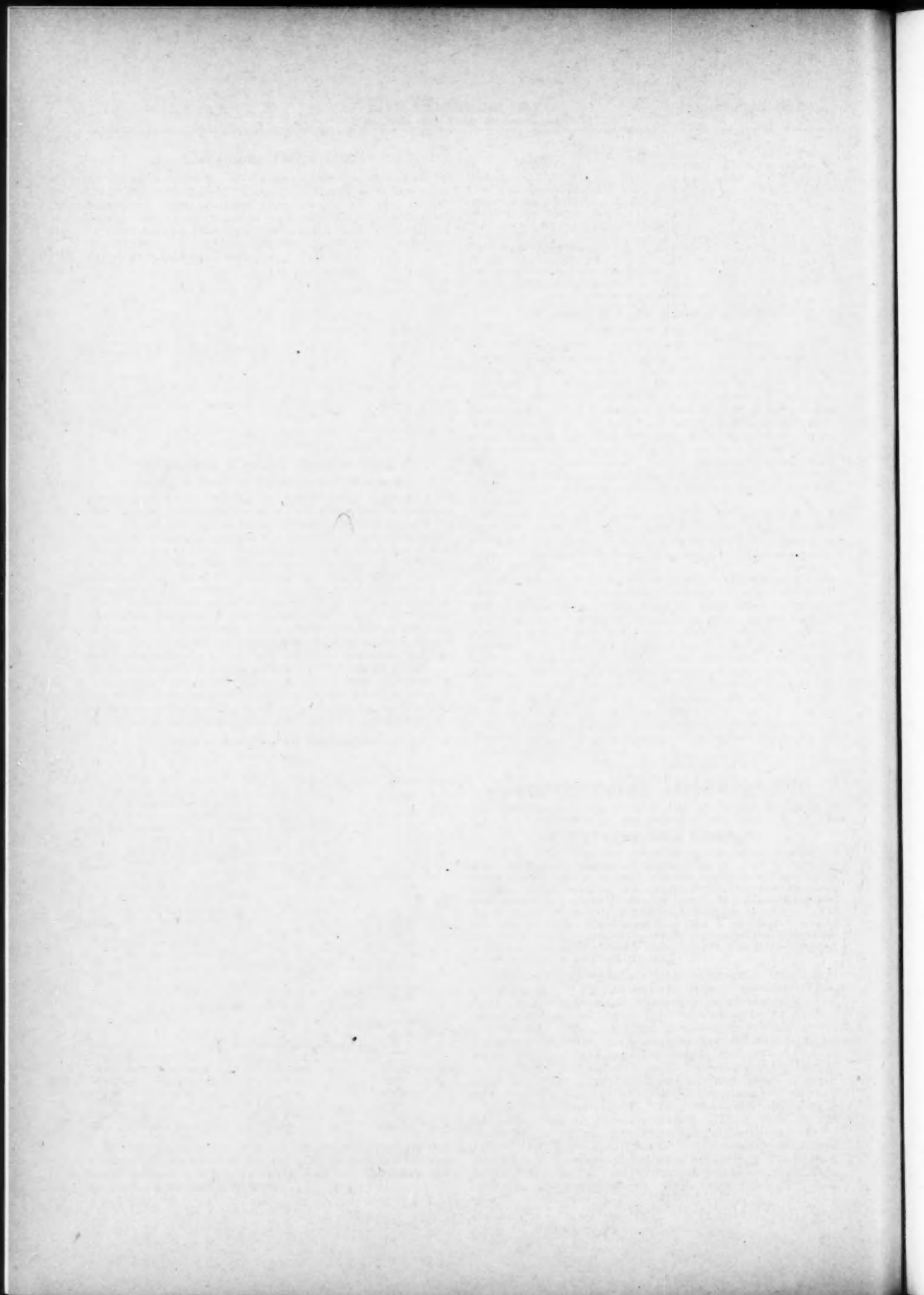
BOOTH'S, LTD., Tunstall, earthenware manufacturers. Registered December 13, £2,000 debentures, balance of £5,000; general charge. *£15,475. October 17, 1928.

EBURITE PAPER CO., LTD., London, N.W. Registered December 5, £25,000 debentures and bonus of 5 per cent.; general charge. *£38,000. December 31, 1927.

STANLEY PROPERTY, LTD., Stoke-on-Trent. Registered December 22, £3,000 debenture, to T. C. Wild, Blythe House, Blythe Bridge, china manufacturer; general charge.

TURNER PAPER MILL CO., LTD., Goole. Registered December 7, £125,000 debentures (secured by Trust Deed dated November 29, 1928); charged on properties at Rawcliffe, etc., also general charge. *Nil. June 28, 1927.





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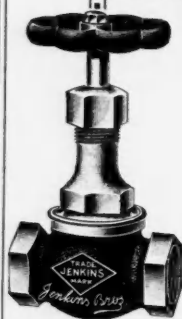
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Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

New B.D.C. Colours

IMPERIAL CHEMICAL INDUSTRIES, LTD. announce the issue of two more B.D.C. colours—Chlorazol Fast Scarlet GS, an addition to the range of direct cotton colours, and Icy Red G, an addition to the range of Icy (direct viscose) colours for viscose artificial silk.

Icy Red G possesses the valuable property of giving even shades when applied to artificial silk of irregular dyeing power. In combination with the other members of the Icy range, it is eminently suitable as the red component in mode shades. Its fastness to washing, water, and scrooping is described as good. It is applicable to union materials containing artificial silk, giving solid shades at the boil on wool-viscose unions. Being easily dischargeable, it is recommended to printers for dischargeable ground shades.

Chlorazol Fast Scarlet GS, being considerably more soluble than the ordinary brands of direct scarlets, is of particular interest for machine dyeing, and is also suitable for application to all types of cotton materials for those purposes where direct cotton scarlets of good fastness to acids, alkalis, and light come into consideration. It gives very yellowish shades, and in combination with Chlorazol Fast Scarlet 8BS and 4BS covers a wide range. Owing to its property of "non-staining" wool, it is of particular use for covering the cotton in wool-cotton union materials. In addition, it is suitable for dyeing artificial silk, paper, and jute.

Sandoz Fashion Shades

THE Sandoz Chemical Co., Ltd., of Bradford, sole consignees for the Sandoz Chemical Works of Basle, forward an attractive pattern card illustrating ten fashionable shades for spring. These shades have been prepared on two different kinds of material. Those on wool are obtained by the combined use, in different proportions, of course, of Alizarine Light Blue RG, Azo Rubinole 2G, and Xylene Light Yellow 2G, described as "level dyeing colours of excellent fastness to light." Those on cotton-viscose are obtained from the use of Cotton Viscose Brown 35 and BC, and the following colours from the Chloramine range—Fast Orange TRL, Fast Blue 8GL, Fast Green B, Fast Yellow 4GL, Fast Pink B, Fast Cutch Brown PL, Fast Brown BC, Fast Orange WS, and Fast Blue 4GL, described as "the most suitable fast direct colours." The effects on the wool fabric are softer and deeper, those on the cotton-viscose brighter and more glossy. The ten shades shown are Honeysuckle, Pewter, Parakeet, Petunia, Mirage, Crevette, Dune, Afterglow, Jersey Blue, and Beechnut.

"Tetracarnit"

FROM the same company comes an interesting pamphlet describing the uses and properties of their patented product, "Tetracarnit," a liquid which, added in small proportions to the dye bath, increases the solubility of the dyestuff and correspondingly increases the liveliness and penetration of the dyeing. The efficiency of this agent lies chiefly in its effect in dispersing the colour more minutely throughout the solution, although it also assists the material to take up the dye more readily. The greater

colour dispersion gives to the dye-liquor increased even-dyeing properties and enables it to carry the colour further in its penetration of the fibre. "Tetracarnit" may be employed in neutral, alkaline, or acid baths, and with its addition, it is claimed, dyed shades are brighter, freer from bronzing, and faster to rubbing. Standing baths containing it keep for a longer period. Some illustrations of penetration tests on balls of felt indicate very good results.

The Guild Colorimeter

FROM Adam Hilger, Ltd., the well-known instrument makers of 24, Rochester Place, Camden Road, London, N.W.1, we have received a quantity of literature relating to two instruments of great interest in the colour industry—the Guild Trichromatic Colorimeter and the Spectrophotometer. The Colorimeter is an instrument for the analysis, measurement, and specification of colour designed by Mr. J. Guild of the National Physical Laboratory, and is one of the outcomes of extensive colorimetric researches during which the need for such an instrument was plainly felt. Its form of construction is such as to render it highly suitable and convenient for practical industrial colorimetry. By its use in industry, whatever colours are chosen as "standards" may be accurately standardised under standard conditions of observation and measurement. Its advantages are thus summarised by the makers:—

(a) The colour measurement is given in a universal form. The principal individual constants of the instrument are eliminated and the measurement is thus rendered independent of essentially arbitrary units; (b) the paths traversed by the three primary beams are wholly identical, so that no errors can arise through differences in different light paths; (c) all colours, including highly saturated colours and purples, are included within range of accurate measurement by the instrument; (d) accuracy of measurement is retained throughout the whole range of brightness practically met with; (e) for each primary, readings are taken on a scale having continuous adjustment and using the same colour filter. They are thus not subject to inaccuracies in the reproduction of a set of filters; (f) the measurements obtained are not affected by any possible variations in the transmission of the primary filters.

In a general note, the makers remark: "How often is the colourist or scientist able to feel confident in his descriptions of the subtle tints which he requires to record, unless samples are also kept? Colours, old and new, are known by attractive names, but although these names are often ingeniously descriptive they are rarely completely so. Putting on one side such ephemeral absurdities as 'elephant's breath,' who, even of those that remember them vaguely, could precisely match the 'electric blue' of 1882, or the 'crushed strawberry' of twenty years later; and who, in a few years to come, will know what we now mean by 'pastel pink,' 'nègre,' 'jade green,' 'mushroom colour,' or any of the other delightful tints of this year's Ascot? Moreover, in the conventionally standardised colours of manufacturers, such, for example, as 'lavender greys,' important variations have been found to exist. Errors of this nature may often mean material loss to the colour manufacturer, and his only real and permanent

safeguard is a reliable and accurate measurement. This is now made possible by the Guild Colorimeter. In works control, for tests of uniformity and of stability, etc., this instrument is of extreme importance to all colourists. It is equally of considerable value to physicists and naturalists."

Spectrophotometry

The form of spectrophotometer described by Adam Hilger, Ltd., is one that the firm put on the market just before the war, and in the United States it has come very much to the fore in the examination of dyes and other organic substances. The wide range of work for which the instrument is useful is clearly indicated in the *Bibliography of Absorption Spectra*, prepared by Dr. Wallace R. Brode, who has done so much work in this field of late years. In the dye industry it is described as particularly useful in the determination of concentration and purity, since the absorption spectrum of a dye gives a measure of its colour purity as well as its concentration. Standard curves of commercially important dyes have been prepared by the Dye Laboratory of the U.S. Bureau of Standards on a number of the most important dyes. In the quantitative estimation of dyes of known composition, to determine the amount of salt or other non-absorbing material present it is not necessary to determine the entire absorption band, but only the intensity of absorption of the maximum of the band. The ratio of this to the maximum absorption intensity of the standard curve gives the amount of the dye present.

Italy's Aniline Dye Industry

In the Bulletin of the British Chamber of Commerce for Italy, considerable attention is given to the aniline dye industry in Italy and the part this country plays in it. Since the war, it is stated, Italy has made undoubted progress, but even now more than 50 per cent. of the business is in German hands either directly or indirectly. German houses have recovered very largely the lost ground of the war period, and of the annual dye turnover of 200 million lire at least half goes into the hands of Germany, about 40 million to Switzerland, 30 million to France, while Great Britain, the United States and Holland can lay claim to about 5 million each, and the remainder is done by the "Unione Colori," an organisation which was established for the sale and distribution of dyes under reparations of war. The success of the German houses is due principally to the quality of the German products, to the up-to-date organisation of the German firms, and the broad methods that they adopt in securing business outside their own confines. The big German producing houses have one central selling organisation established in Italy, the "A.R.C.A." (Aziende Riunite Coloranti Affini), which, though ostensibly an Italian concern, owes three quarters of its capital to the German houses, the rest being Italian.

Among Swiss houses the "C.I.B.A." (Società Chimica Basilea) does some excellent business, having seized the opportunity during the war when competitors from other countries were perforce excluded. S. A. Sandoz and S. A. Geigy, both well-known Swiss houses, are well to the fore. British firms to be found on the Italian market are few. The British Dyestuffs Corporation are represented through the "Industria Nazionale Colori Anilina," of Milan, and Messrs. Holliday also have an agent in the same city. Among American houses there are the National Aniline Co., while Dupont de Nemours of Washington are said to be contemplating the possibility of business.

There is undoubtedly a field for British-made dyes, and those which are already selling on the market are appreciated for the excellency of their quality, added to which there are a large number of dyes made in England for which

there is a wide and steady demand in Italy. What seems to be lacking on the part of British manufacturers is a good organisation for introducing their products and elasticity in the matter of credits. If British dyes are to increase their sale in Italy the manufacturers must take the market more seriously and deal with the problem more broadly.

Research Exhibits

AMONG the exhibits in the research and experimental section at the Exhibition of the Physical Society and the Optical Society, held on Tuesday, Wednesday and Thursday at the Imperial College of Science and Technology, London, were some of interest to the dyestuff industry.

The Brown-Firth Research Laboratories, of Sheffield, had an exhibit illustrating some of the most recent advances in the development of special non-corrodible and heat resistant steels with their applications. These included a demonstration of certain fabrics dyed with the same dyes in vessels made of different metals, showing the true shade of colour obtained when using vessels of Firth Staybrite Steel (these experiments were shown by permission of Mr. J. G. Grundy, and of the Clayton Aniline Co., Ltd., Manchester).

The British Research Association for the Woollen and Worsted Industries showed two new instruments. A new autographic extensometer gave an autographic record of the relation between the tension and the extension of a specimen referred to rectangular co-ordinates, and was designed so as to eliminate the friction error and to minimise the error due to the inertia of the moving parts. The other instrument was a photoelectric yarn levelness tester. The quality of a finished fabric depends largely on the levelness of the yarn used. In this instrument, the yarn was drawn continuously across a beam of light so that at any instant an image of a short length could be focussed on the plane of an adjustable slit. The transmitted light fell on a photoelectric cell and the current produced was measured.

Effect of Chinese Boycott of Japan

A letter from the F.B.I. correspondent in Hong-Kong states that the Japanese boycott still continues, although of course goods fitter through unauthorised channels into the interior. As a result of the boycott, Manchester has benefited from an increased demand for white and grey shirtings and various cotton lines, though the Chinese merchants are afraid to order large quantities of Lancashire cotton goods in case of a sudden cessation of the boycott. It is hoped in China that Manchester will take advantage of the opportunity now presented her, and make every effort to establish British goods in place of those hitherto bought from Japan. Germany is stated to be having considerable success in taking Japan's place in the supply of electrical and other allied goods.

Dyestuff Licenses

The following statement, relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during December has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:

The total number of applications received during the month was 629, of which 520 were from merchants or importers. To these should be added 15 cases outstanding on November 30, making a total for the month of 644. These were dealt with as follows:—Granted, 613 (of which 596 were dealt with within 7 days of receipt); referred to British makers of similar products, 27 (of which 23 were dealt with within 7 days of receipt); outstanding on December 31, 4. Of the total of 644 applications received, 596, or 96 per cent., were dealt with within 7 days of receipt.

Dyes and Their Application: Recent Technical Progress Technical Developments in 1928.—(I)

By L. J. Hooley

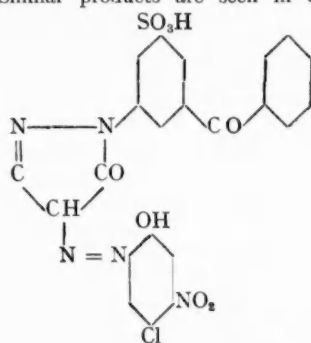
The progress made in the dyestuff and allied industries is, month by month, noted in these columns. In the following article, which will be completed next month, Mr. L. J. Hooley discusses the advances made during the past year.

In the Annual Review Number (recently published) the main points of general interest in connection with the British dyestuffs industry were outlined. The most important of the technical work both in the British and other industries will now be discussed in greater detail, the various colour groups being treated separately.

Speaking generally, there is no diminution in the interest of the published results, the volume of which continues to increase.

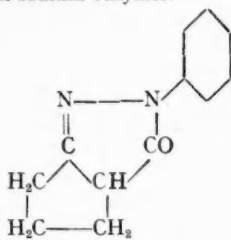
Azo Colours Containing Pyrazolone Nuclei

Among the azo pyrazolones, the tendency is to use highly substituted phenyl rings. Thus, for example, in B.P. 261,770 (I.G.F.A.-G.) 1-(4¹-chloro-6¹-sulpho-3¹-methylphenyl)-3-methyl-5-pyrazolone may be coupled with diazotised *o*-toluidine-disulphonic acid to give a yellow, and, in B.P. 263,816, 4-chloro-5-nitro-*o*-aminophenol is coupled with 1-(2¹-hydroxy-5¹-sulpho-3¹-carboxyphenyl)-3-methyl-5-pyrazolone. This latter product is a chrome red, fast to potting, milling and light (see below). Similar products are seen in other patents



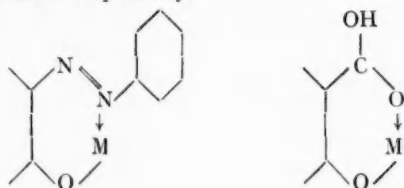
(B.P. 276,353, 290,230, 290,253, I.G.F.A.-G.; and B.P. 281,713, S.C.I.B.) They recall the intermediates at present being used for indigo.

New pyrazolones are prepared in B.P. 260,577 (C. Mannich) by ring-closing phenylhydrazones of cyclopentanone-2-carboxylic esters with sodium ethylate.

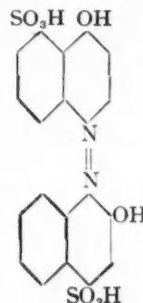


Azo Chrome Colours

In this class, the soluble co-ordinated metal azo compounds are included, the mechanism of the formation of some of which was dealt with in the March DYESTUFFS SUPPLEMENT. The following formulae probably represent the chelate rings in which the metal is held in *o*-hydroxyazo and *o*-hydroxycarboxylic acid derivatives respectively.



A considerable number of further products have since been mentioned. Many of these are obtained by coupling *o*-amino phenols or *o*-aminonaphthols with aminonaphtholsulphonic acids. In some cases, ethers are used instead of the free hydroxy bodies. Some typical examples are to be found in the following British patents: 270,308, 279,429, 283,979, 288,307, 292,344 and 292,660, all from the I.G.F.A.-G.; and B.P. 289,049 (S.C.I.B.). From these one example may be selected. 1:2:4-aminonaphtholsulphonic acid is diazotised and coupled with 1:8-naphtholsulphonic acid. The product is red, but may be converted to its chromium compound, which dyes greenish blue shades. If the red is treated with chrome on the fibre, a grey is obtained. The red body has the structure shown below.



In B.P. 289,094, a diazotised 5-nitro-2-aminophenol is coupled with an *N*-alkyl-, *N*-arylalkyl-, *N*-aryl-, *N*-alkylene- or *N*-arylene-2:5:7-aminonaphtholsulphonic acid, and then converted to a soluble chromium compound by refluxing with chromium fluoride solution.

In some cases the products are stated to be useful as insecticides, as well as for dyeing. According to B.P. 262,418, chrome dyes of different shades are obtained if in the chroming treatment an additional salt such as sodium chloride, which has no mordanting properties, be added; for example, the compound obtained from 4-nitro-2-aminophenol-6-sulphonic acid and β -naphthol gives a black with chromium formate and sodium chloride instead of the violet-brown given with chromium formate alone. In B.P. 282,783, *o*-hydroxy-azo dyes of the pyrazolone series are converted to soluble chromium compounds, shades from orange to red being mentioned. Soluble metal compounds of *o*-hydroxyazo-pyrazolone dyes, for example, the chromium compound of the dye obtained from 2-aminophenol-4-sulphamide with 1-(3¹-sulphamino)-phenyl-3-methyl-5-pyrazolone, is used for obtaining transparent coloured varnishes.

Where amino- or nitro-groups are present in the chromium compound of the dyestuff, these may be modified without destroying the metal complex. (B.P. 268,754, I.G.F.A.-G.).

Chromium azo dyes may also be sulphurised to give products dyeing from a sodium sulphide bath. Thus 1:2:4-aminonaphtholsulphonic acid is coupled with α -naphthol, treated with chromium fluoride, and refluxed with sodium sulphide and sulphur, a reddish-blue product resulting.

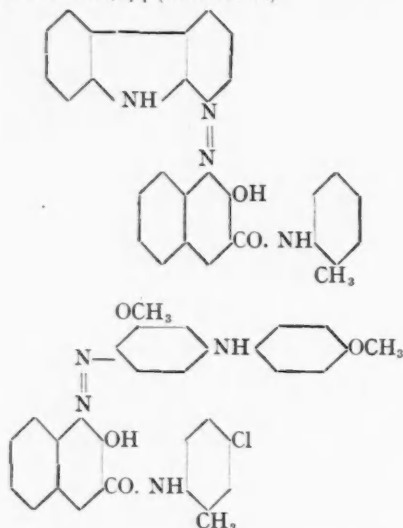
A considerable number of other products adaptable for use with the ordinary chroming processes are also to be found (B.P. 265,203, 285,097, 288,570, 289,135, 293,352). In B.P. 289,983 (I.G.F.A.-G.) azo dyes of the Naphthol AS type suitable for after-treatment with chromium are described.

Developed Azo Colours

With the satisfactory nature of these colours, the search for new products continues. The simpler possibilities having been exhausted, the newer compounds are in general more complex; the complexity is, however, in some cases, accompanied by greater fastness.

The developing bases include a large number of methyl-

and chlor-derivatives, such as dichloraminotoluenes, chlor-aminoxylens, and dichloraminoxylens, as well as even more highly substituted bodies (B.P. 275,613, 286,274, 287,479, 287,908, 294,128, I.G.F.A.-G.). The amines used in the production of the arylamides may also be similarly substituted. Carbazole derivatives have also been used both as bases and to take the place of the naphthols (B.P. 275,326, 282,682, F.P. 617,211, I.G.F.A.-G.). Diphenylamine derivatives are employed in B.P. 286,274 (I.G.F.A.-G.).



In B.P. 284,247, the naphthols are coupled with amines containing a second amino group substituted by a benzoyl or similar radicle.

Sulphones and sulphonamides are also used. 2:3-oxy-naphthoic amides are condensed with mustard oils (B.P. 289,037, I.G.F.A.-G.). In B.P. 292,100 (I.G.F.A.-G.), the diazonium and tetrazonium borofluorides of arylamines are used. E. Gebauer-Fülneegg and W. Specht (Austr. P. 105,341) obtain coupling in the hydroxyl group by coupling 1-substituted β -naphthols.

E. I. Orloff (*Melliand Textilb.*, 8, 794) proposes to overcome the difficulties attendant on the use of the naphthols for wool and silk by grinding β -naphthol with sulphuric acid, and then an amine, whereby an arylamine salt of a naphthol sulphonic acid is obtained; the fabric is treated with this followed by sodium nitrite.

Leitch and Co., A. E. Everest, and J. A. Wallwork, dye silk and wool in the presence of soap without or with only a little added alkali (B.P. 283,347, 283,838-9).

Cellulose Acetate Dyes

This section having been dealt with as lately as December in the DYESTUFFS SUPPLEMENT, little need be said except to emphasise the amount of research work which is still proceeding in this country, and which at the present time is directed mainly to azo and anthraquinone compounds, and especially to compounds with long side chain substituents.

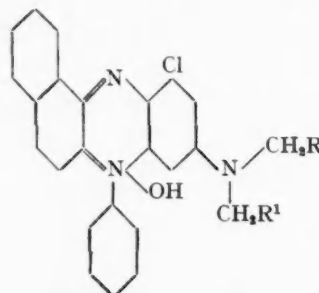
Basic Colours

There is rather more to be seen in this section than during the two previous years. Goldstein and others have continued their work on the carbazines and azoxines in a few papers in *Helvetica Chim. Acta*, while Bistrzycki and Niederberger have a paper on 3,3'-difuchsonyl and related derivatives.

A series of products having excellent properties for type-writer ribbons, indelible pencils, and copying inks are protected by the I.G.F.A.-G. (B.P. 282,804, 283,777, and 288,214). In each case a basic dye is diazotised and coupled with an azo constituent. Various safranines are used along with cresols or β -diketones, such as ethyl malonate. Alkylamino- or dialkylamino-groups are used in one or both constituents.

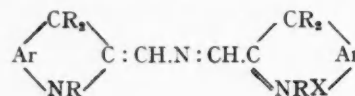
Geigy's have a number of azine dyes of isorosinduline and safranin type in B.P. 284,614-5 and 284,614 (which are additions to B.P. 265,986 mentioned last year) and in B.P. 282,803. Both their synthesis and sulphonation are included. As an

example, the isorosinduline of the type shown below may be mentioned.



Substitution of 1:3-di-(*p*-alkoxyphenylamino)naphthalene sulphonic acids for the more usual 1:3-diphenyl- and ditolyl-amino acids enhances the fastness to light of dyes of the Wool Fast Blue type (B.P. 275,724 I.G.F.A.-G.).

Brilliant greenish-yellow dyes are obtained from 2-methylene-1:3:3-trialkylindoline salts with nitrous acid.



Acridines for internal antiseptics are described by A. G. Green (B.P. 293,617) and also by the I.G.F.A.-G.

Tschlikin (*Melliand Textilber.*, 8, 265) describes the best conditions for dyeing Aniline Black, and the I.G.F.A.-G. deals with the production of analogous blacks on furs, pelts, etc., in B.P. 289,730 and 290,126.

Various aspects of mordanting are dealt with in three or four other publications.

Triphenylmethane Dyes

The manufacture of Lissamine Green from 4:4'-tetra ethyl-diaminebenzhydrol and 2:7-naphthalenedisulphonic acid has been improved (B.P. 287,995, B.D.C., T. A. Simmons).

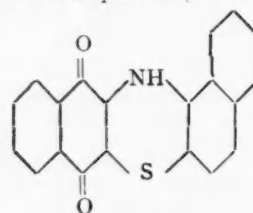
In B.P. 289,092, diaminotriphenylmethanes are produced by condensing benzaldehyde disulphonic acids with propyl or higher alkylated amines.

The new method of B.P. 272,321 of producing triaryl-methane and similar derivatives is extended in B.P. 289,571 (B.D.C., W. H. Cliffe, F. W. Linch and E. H. Rodd) to compounds containing methyl and methylene groups.

Chromable triphenylmethane dyes are obtained by using *o*-hydroxycarboxylic acids in B.P. 291,887 (I.G.F.A.-G.) and U.S.P. 1,663,869 (O. Wahl).

Sulphur Colours

A few developments are to be reported here, where vat dyestuffs containing sulphur, but applied from the hydro-sulphite vat, are included along with the ordinary sulphur colours. Among the former are the carbazole quinones obtained by the action of sulphur on thiazine quinones. α,β,β' -Dinaphthacarbazolequinone (shown below) dyes



orange red. There are also the thiazoles obtained from 2-amino-3-thiol-1:4-naphthaquinone, which are greenish-yellow in shade and give dyeings fast to washing and bleaching (B.P. 262,141, I.G.F.A.-G.).

Among the true sulphur colours, the majority of patents deal with indophenols. In B.P. 285,382 (I.G.F.A.-G.), the nuclear nitrogen forms part of a hydrogenated ring system. Dihydroindoles are used in B.P. 286,005 and G.P. 443,685 (I.G.F.A.-G.) where the usual sulphide melt is unsatisfactory, thiocyno-groups are recommended (B.P. 289,241, I.G.F.A.-G.).

Semi-carbazide, guanidine and similar substances are added to the melt in B.P. 280,595 (S.C.I.B.), instead of the urea of the parent specification (B.P. 270,348).

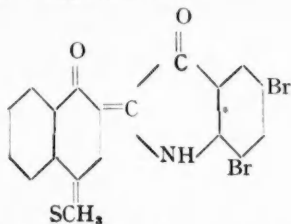
Vidal produces sulphur blacks from di- and tri-nitrophenols by melting with sulphur and a nitrosophenol (B.P. 283,468). Both here and in B.P. 283,467 isolation of products is aided by adding ammonium salts.

Indigo

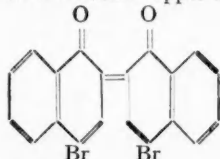
Polysubstituted benzene derivatives for the production of indigos are mentioned elsewhere. In B.P. 281,290, halogen-alkyl-benzenes are heated with chlorosulphonic acid to give sulphochlorides, these are then reduced and condensed with chloroacetic acid. *m*-Chlortoluene gives 1-methyl-5-chlorbenzene-2-sulphochloride.

Dimethoxy- and diethoxy-benzoic acids are converted to thioglycolic acids by nitrating, reducing and then substituting the amino group in the normal way (B.P. 291,361).

Two new halogenation patents are B.P. 292,904 (Newport Co.) and 295,329. These deal with the bromination of 4:4'-dimethyl-6:6'-dichlorothioindigo and monoalkyl-2:2'-indolethionaphthene-indigo, monoalkylated in the indole benzene nucleus. There has been a revival of interest in substituted naphthol derivatives as constituents. In B.P. 292,815 (I.G.F.A.-G.), isatin- α -chloride is condensed with α -naphthol containing a substituted mercapto- group in the 4-position; the example below is greenish blue.



In B.P. 289,154, somewhat similar constituents without the sulphur, i.e., ethers of 1:4-dihydroxynaphthalene are used. An indigo type of structure has been assigned by Willstätter and Schuler to the products obtained on treating 2:4-dibrom- α -naphthol with alkali or metallic copper in alcohol.



Water-soluble indigo products are obtained by treating N-acylated indigos with sulphites. They are hydrolysed to indigo by sufficiently strong treatment with alkali. As an example N,N'-diacetylindigo may be heated for about half an hour with 40 per cent. bisulphite under reflux (D.R.P. 445,566, I.G.F.A.-G.). Water-soluble isatin derivatives are also obtained by the action of sulphites upon isatin- α -chlorides (B.P. 282,863, I.G.F.A.-G.).

A new synthesis of isatins starts from sulphonamido derivatives, which are combined with oxalyl chloride, the oxaminic acids ring-closed, and the sulphonogroups then removed by hydrolysis.

Wool Vat Dyestuffs

Of the vats produced solely or mainly for wool, there is little to report. Some new reduced preparations are described, and the use of alkali starch may be mentioned (B.P. 278,890, I.G.F.A.-G.).

Benzanthrone

A greater number of British patents have been taken out on this subject than in any previous year. Scottish Dyes, the British Dyestuffs Corporation, L. B. Holliday, and the British Alizarine Co. all contributing. The Society of Chemical Industry in Basle have also a number to their credit, while the German firms are still working hard in this field. With the discovery of the dibenzanthronyls, the synthesis of dibenzanthrones and isodibenzanthrones having substituents in known positions has been facilitated. Some extensions of the glycerol type of synthesis of benzanthrone are to be noted, as well as the production of nitro-, halogen-, methyl- and

methoxy- benzanthrone from benzanthrone itself. These can be converted to dibenzanthronyls and these in turn to vat dyestuffs.

The patents are too numerous for more than a few to be specifically mentioned. The British Alizarine Co. with W. H. Dawson, C. W. Soutar and P. Beghin have introduced economies in alkali fusions, and the production of chlorinated derivatives has been carried back to the stage of the actual synthesis of benzanthrone from glycerol (B.P. 284,035 and 281,016). The production of blacks by oxidation methods has been extended (B.P. 295,506, L. B. Holliday and C. Shaw). Bluish-grey, bluish-black, blue-green and black dyestuffs have been obtained starting from sulphonated benzanthrone and by condensation with hydroxylamine (B.P. 276,766-7-8, 279,205, and 280,652, B.D.C., J. Baddiley, A. Shepherdson and S. Thornley).

The dibenzanthronyl previously prepared as in B.P. 251,313 is obtained in purer form in B.P. 278,112. The same method is extended to substituted derivatives in B.P. 278,496, and other additional patents have also been taken out by Scottish Dyes, J. Thomas and R. F. Thomson.

The dibenzanthronyl sulphide and related derivatives have been extensively examined by the I.G.F.A.-G., and several dibenzanthrone derivatives obtained from these and other compounds. Several green and black vat dyestuffs have also been described.

(To be concluded)

Dyes in China

Increasing Use of Vat Colours

INTENSIVE competition and the increasing use of vat dyes are both dealt with by Mr. H. H. Fox in his report on the Commercial, Industrial and Economic Situation in China for the year up to September 1, 1928. The trade, he states, was again seriously affected by the political situation, banditry, etc., but in spite of all internal troubles there was a remarkable increase in the imports of dyes. As regards indigo, the "war" between American and German producers was carried on, but the American attack weakened and prices remained fairly steady, at a level far from remunerative to manufacturers. Towards the end of the year, however, prices increased a little. Total imports of dyes of all types into Shanghai, calculated on the 20 per cent. basis, increased from 350,000 to 384,000 piculs. Imports of indigo, 20 per cent., showed a further decline, but this is more than compensated by the increased imports of indigo white, which reduces the time taken in dyeing and being in a more concentrated form saves consumers a good deal on freight charges. It threatens to displace the ordinary indigo at no far distant date. The Germans still retain the dominating position in the indigo market, largely on account of the sales of indigo white. German and British importers have improved their position during the year at the expense of the Americans, French and Swiss. Small imports of indigo came from Italy, a new competitor.

Aniline Dyes

Importations of aniline dyes into Shanghai show a very substantial increase for the year, the major portion of the increase being to the credit of the Germans and Swiss. The American importers barely succeeded in holding their ground, whilst the imports from Great Britain doubled, amounting this year to 7 per cent., as against 4 per cent. of the total imports last year. This result is largely due to the stronger position of the British dyestuff industry brought about by its amalgamation with other important chemical manufacturers of Great Britain. Prices continued their general decline. A small boom was experienced immediately after China New Year (February, 1928), and large sales were made at somewhat firmer prices owing to the opening up of certain lines of communication. Dealers were soon stocked up, however, and prices quickly returned to their former level and the year finished fairly quietly.

Increasing Use of Vat Colours

One notable feature during the year was the increased use of vat colours in certain Shanghai factories. The Germans were the only importers concerned, but the matter is worthy of note as the vat colours are the fastest class extant, and the increased use of vat colours is in keeping with the practice in the west.

Technical Notes on Colour Lakes.—(2)

Precipitating Agents, Dyestuffs, and Applications of the Products

In last month's "Dyestuff Supplement," the first part of this article, dealing with general considerations, was published. The concluding portion, published below, deals with more detailed matters.

It is interesting to note that certain manufacturers maintain that the best quality aluminium hydrate can only be produced in the cold. This method, however, must necessarily take up a considerable amount of time, but it is claimed that the results warrant the extra time spent in manufacture.

Alumina blanc fixe.—In preparing this base the sodium sulphate formed during the precipitation of the aluminium hydrate is used up in the formation of barium sulphate by adding barium chloride to the unwashed aluminium hydrate.

6 lbs. Aluminium sulphate (18 per cent. Al_2O_3) are dissolved in

6 gallons hot water (60–70°C)
now add while constantly stirring :—

2½ lbs. soda ash in

2½ gallons hot water (60–70°C)

stir for some time and when effervescence has ceased add :—

6½ lbs. barium chloride dissolved in

6½ gallons hot water (60–70°C).

After stirring some time the paste is allowed to settle and washed free from soluble salts by decantation. The paste is filtered and pressed.

Blanc fixe.—Several methods are used for the production of this base according to the ideas of the particular manufacturer. The following is a general method in use :—

24 lbs. calcined Glauber's salt (or 55 lbs. crystals) are dissolved in

24 gallons hot water (60–70°C) cool to 30°3 and add

40 lbs. barium chloride dissolved in

40 gallons water (30° C).

The precipitate is now allowed to settle and is washed and filtered.

Satin white.—Considerable skill is required to produce a good satin white, and each manufacturer has his own particular method. The following is a general works recipe :—

16 lbs. quicklime are slaked with water to a good thick cream and then mixed with

34 lbs. aluminium sulphate dissolved in

34 gallons hot water (60–70°C).

The mixing is carried out at 60–70°C, and after agitating the mass is allowed to stand several hours, and is then washed and filtered.

Precipitating Agents

The choice of precipitating agents is controlled by the nature of the dyestuff to be used, and in certain cases is still further limited by the particular shade or effect it is desired to produce. The principal precipitating agents used in the lake-making industry are barium chloride, calcium chloride, zinc sulphate, lead acetate, tannic acid, rosin soap and fatty soaps.

The usual manner in which the precipitating agents are used is to prepare ten per cent. solutions and to add, while stirring, to the mixture of dissolved dyestuff and base in paste form already contained in the precipitating vessel.

Dyestuffs for Lake Manufacture

For purposes of classification we may divide the colours suitable for lake manufacture into the following classes :—

(1) Insoluble azo dyestuffs with no lake-forming properties.
(1A) Insoluble or partially soluble azo dyestuffs which possess lake-forming properties.

(2) Acid dyestuffs.

(2A) Direct cotton dyestuffs.

(3) Basic dyestuffs.

(4) Dyestuffs of the Eosine class.

In making this classification the method of precipitation rather than the chemical constitution has been taken into consideration.

(1) Insoluble azo dyestuffs with no lake-forming properties.

Monolite Fast Scarlet RN Paste and Lumps.

Monolite Red 2G Paste.

Monolite Red B Paste and Powder.

Monolite Yellow G Paste and Lumps.

Lake Green B Paste, Powder and Lumps.

(1A) Insoluble or partially soluble azo dyestuffs which possess lake-forming properties.

Monolite Red C Paste.

Monolite Red D Paste.

Monolite Red P Paste.

Monolite Red R Paste and Powder.

These dyestuffs find extensive use in the production of colour lakes for oil paints, printing inks and paper surfacing.

(2) Acid dyestuffs.—These dyestuffs are all water soluble and require to be precipitated from their water solutions. The precipitating agents most commonly used for this class of colours are barium chloride, calcium chloride, and zinc sulphate. Certain dyestuffs of this class have the property of combining directly with aluminium hydrate. Such colours are Durasol Fast Blue BL Concentrated, Acid Yellow 85539, Gallocyanine BD, and are particularly useful where transparency in the finished lake is desirable. The acid dyestuffs find their largest use in the production of colour lakes for printing inks and paper surfacing.

The dyestuffs in this class of special interest to the lake-maker are :—

Quinoline Yellow.

Naphthol Yellow FY.

Acid Yellow 85539.

Metanil Yellow Y.

Lissamine Fast Yellow 2G.

Citronine R Conc.

Citronine Y Conc.

Lake Yellow R.

Acid Orange G.

Acid Orange R.

Lake Orange O.

Durocyanine Violet R.

Coomassie Acid Blue RL.

Soluble Blue 3M.

Soluble Blue 2R.

Pure soluble Blue.

Alkali Blue 4B.

Disulphine Blue A.

Disulphine Blue V.

Lake Scarlet 3B.

Acid Scarlet R.

Acid Scarlet 2R.

Acid Scarlet 3R.

Acid Scarlet 4R Extra.

Brilliant Carmine L.

Brilliant Acid Maroon.

Pure Bordeaux B.

Fast Acid Violet 2R.

Coomassie Violet R.

Gallocyanine BD.

Durasol Fast Blue BL Conc.

Lake Blue A.

Lissamine Green V Conc.

Lissamine Green SF.

Alizarine Cyanine Green G

Conc.

Acid Green G.

Naphthol Green B 9211K.

Nigrosine G Crystals.

(2A) Direct Cotton Dyestuffs.—The direct cotton dyestuffs find no extensive use in lake-making, but in the isolated cases where they are used they are treated as acid dyestuffs. The most important dyestuffs of this class are :—

Chrysophenine G.

Chlorazol Fast Yellow R Extra.

Chlorazol Black EFH.

(3) Basic dyestuffs.—These dyestuffs are water soluble, and are commonly precipitated with tannic acid, aluminium phosphate, aluminium arsenite and aluminium silicate. They find extensive use in the production of lakes for paper surfacing and printing inks. Printing inks prepared from these colours, unfortunately, have a tendency to dry rather slowly.

The basic dyestuffs, particularly Brilliant Green Crystals Y, find extensive use in the production of lime colours fast to light and lime. For the production of so-called lime colours the water solution of the basic dyestuff is merely mixed with green earth, white earth or mixture of both, when it will be found that the colour is completely precipitated.

The following dyestuffs come under this class :—

Acronol Yellow T.

Auramine O.

Chrysoidine YRP.

Bismarck Brown G.

Bismarck Brown R 100s.

Magenta 2B Powder.

Magenta P Powder.

Safranine T Conc.

Tannin Pink C Extra.

Acridine Orange LP. New.

Methyl Violet 2B.

Methyl Violet 10B.

Indine Blue 2RD.

Methylene Blue 2B.

Victoria Blue B.

Victoria Blue R.

Acronol Brilliant Blue.

Turquoise Blue G.

Brilliant Green Crystals Y.

Malachite Green Crystals A Conc.

(4) Dyestuffs of the Eosine Class.—Dyestuffs of this class are precipitated almost exclusively with lead acetate, yielding beautiful shades of reds and pinks for printing inks. They are used to some extent in the production of full bright red to scarlet shades by precipitating on red lead, such lakes being used in the manufacture of certain types of paints.

Included in this class are the following:—

Eosine 3Y.
Eosine YS.
Eosine BS and 2BS.
Phloxine B.

The following survey indicates generally the practice of the most important branches of the lake-making industry. It must, however, be realised that new products are constantly being added to the range and enquiries are invited for dyestuffs which may be required for some special purpose and which may not be found illustrated in this book.

Colour Lakes for Oil Paints and Varnishes

Dyestuffs:—All the dyestuffs in classes 1 and 1A and certain of the dyestuffs in classes 2 and 4.

Bases:—Barytes, lithopone, red lead, ochres, zinc white, alumina blanc fixe, blanc fixe, aluminium hydrate.

Precipitating agents:—Barium chloride, calcium chloride, lead acetate.

These lakes are produced in the dry state either in the form of powders or lumps. The essential features of such colour lakes are that they possess good covering power, good fastness to light, oil and, in certain circumstances, good fastness to spirit.

The dyestuffs to be used in the preparation of such colour lakes must, therefore, be carefully chosen, taking into consideration the uses to which the colour lake is to be ultimately put. If, for instance, the finished paint is to be used on articles only painted in one colour, fastness to oil is of no great importance and, therefore, a dyestuff which is to some extent soluble in oil could be used.

Colour Lakes for Typographic and Lithographic Inks

Dyestuffs:—All dyestuffs in classes 1, 1A, 2, 3 and 4.

Bases:—Aluminium hydrate, alumina blanc fixe, blanc fixe.

Precipitating agents:—Barium chloride, calcium chloride, lead acetate, tannic acid, aluminium phosphate.

These colour lakes are produced in the form of lumps and powder and very rarely in the form of pastes.

The lakes are ground usually on a three-roller mill with lithographic varnish, which consists of linseed oil boiled to the required consistency.

In choosing dyestuffs for the preparation of these lakes great care must be exercised in that the dyestuffs must be chosen according to their properties and to their manner of application. Dyestuffs which are to be used in the production of lithographic inks must essentially be fast to water, and must possess some body, while at the same time retain a certain degree of transparency. Dyestuffs possessing the greatest possible colouring power are the most suitable for this class of work as it is the object of the lithographic printer to obtain the maximum colour strength with the minimum quantity of colour lake.

A very important point to be borne in mind is that these colour lakes must be entirely free from acidity.

For typographic inks the colour must possess full body and must be fine and light in texture, otherwise extensive trouble may be experienced in the "filling up" of the type.

In producing colour lakes for "offset printing," colours are required which possess high colouring power, and at the same time good body and density.

These remarks also apply to colours for tin-plate printing, but in certain circumstances a high degree of transparency is required for this class of work. In addition to this, the colour lakes for tin-plate printing must withstand stoving at a temperature of approximately 140° F.

For the production of colour lakes for "three colour printing," the essential feature is that the dyestuff chosen must be capable of giving lakes possessing good transparency.

It is sometimes desirable to lacquer the articles to be printed with spirit lacquers, and under such circumstances it is essential that the dyestuffs used should be fast to spirit, otherwise bleeding of the print will result.

Colour Lakes for Paper Coating and Surfacing

Dyestuffs:—All dyestuffs in classes 1, 1A, 2, 2A, 3 and 4.

Bases:—Alumina blanc fixe, china clay, satin white, blanc fixe.

Precipitating agents:—Barium chloride, calcium chloride, tannic acid, aluminium arsenite, aluminium phosphate, aluminium resinate.

These colour lakes are almost invariably produced in the form of wet pastes or, to use the trade term, "pulp colours." The pulps are mixed with agglutinants such as glue, starch, casein or calcium resinate and applied to the paper by means of the paper coating machine or printed by the ordinary wallpaper printing machine.

The most essential features of such dyestuffs are cheapness, and whenever possible good fastness to light, water and lime.

The fastness requirements vary considerably with the purpose for which the coloured papers are to be used. Thus, it is not necessary for lining papers to be of good fastness to light, whereas this would be necessary in the case of high-class wallpapers.

Lime Colours

Dyestuffs:—All dyestuffs in classes 1, 1A, with the exception of Monolite Red P Paste, and all dyestuffs in class 3.

Bases:—Barytes, lithopone, green earth, white earth, blanc fixe.

Precipitating agents:—Barium chloride, calcium chloride.

These colours are produced both in pastes and in powders and find their biggest outlet in their production of distempers, lime washes and water paints. Each manufacturer of these commodities has his own particular specialities, but speaking generally, the colour lakes are diluted down with various white bases such as lime, chalk, barytes, etc., and are then mixed with certain sizing agents. The essential features of the colours used in the production of lime colours are good fastness to lime, light and water.

The K.B.B. Fugitometer

Its Uses in the Dyeing Industry

THE result of prolonged research by the British Research Association for the Woollen and Worsted Industries, the K.B.B. Fugitometer, manufactured completely in Glasgow, is a practical apparatus for the rapid testing of the fastness or otherwise of dyed and coloured materials generally. Besides ordinary wool, cotton, and silk textiles, the Fugitometer is applied to coloured papers, lithographic colours, dyes, and also to the testing of rubber, rubberised fabrics, and like products. The apparatus carries 16 double sample boxes, through which humidified air can be circulated. The sample boxes are hinged, so that during testing the samples may be viewed without disturbing the humid air circulation. A humidifying box and circulating motor are built in the apparatus, which is quite complete in itself and carries its own double-pole switches. The course of testing light is a special form of carbon arc lamp of intense actinic power, and the whole outfit can be run off either alternating or direct current supplies. The manufacturers are Kelvin, Bottomley and Baird.

A simplified form known as the K.B.B. Fading and Dying Outfit is also made with open sample holders and with a simple humidifying tray which, when desired, can be put into action for making the air in the neighbourhood of the samples humid. This form is less expensive and is applicable to the kind of tests and materials dealt with by the standard Fugitometer.

Another apparatus made by Kelvin, Bottomley, and Baird, Ltd., and applicable to textile dyeing, paint and varnish, and also to chemical and physical examination of all kinds of substances used in industry, is the K.B.B. Fluorescence Cabinets. In these a mercury vapour lamp is used, the radiation being filtered so that only the invisible ultra-violet radiation falls on the samples. By means of the characteristic fluorescences thus excited in the materials all kinds of defects, adulterations, etc., are made visible. It is largely applied in the textile industry to observe such defects as mildew, iron spots, oil stains, etc., which, though invisible in ordinary light, are brilliantly shown up by the ultra-violet beam. Adulteration in paint bases, oils, foodstuffs, etc., is readily observable, bacterial damage and the like is shown up conspicuously, and synthetic materials, in a large number of cases, are readily distinguished from natural products.

Dyestuffs Markets: The Month's Business in Review**From Our Own Correspondents****Yorkshire**

DURING the year just completed one has grown accustomed to report, month by month, a more or less constant turnover. The volume of business in the Yorkshire dyestuff and intermediate trade has been greater than during 1927; turnovers have been higher, and, having regard to the lower prices ruling, probably lower by 15-20 per cent., it must necessarily follow that quantities must have been much higher. December was no exception in the improved state of affairs, although in comparison with other months it bore, as usual, a holiday blemish. Most of the works closed down from the evening of Friday before Christmas, and resumed work on the morning of Thursday after.

The Heavy Woollen District continues to suffer in the home market from competition in smooth-faced cloths from Germany and Czechoslovakia, while there has been a recent development of competition in foreign-made tweeds of medium quality. At a meeting of the Heavy Woollen Manufacturers Association at Dewsbury, a resolution in favour of an application for the safeguarding of the wool textile industry was adopted. Some thirty firms were represented; seventeen voted for the resolution and four against, the latter including representatives of three blanket firms. The safeguarding situation is being closely followed. It is asserted that more mills have been closed in this district than in other parts of the West Riding in the last two or three years owing to trade depression. On the other hand, there has been greater activity recently in the blanket industry, and the prospects for the new year are regarded as hopeful, especially in the China market, from which orders have recently been received for scarlet blankets. Government requirements, too, are helping this branch of Dewsbury's woollen trade.

In Huddersfield, the fine worsted section continues to be well employed, chiefly for export trade, on both plain cloths and fancy weaves. The medium worsted trade is not so well placed, but even here there is quite a good export business. Last month a slight improvement in the woollen trade of Colne Valley was reported. It is being maintained, woollen manufacturers being better employed now than they have been for some time. Employment figures are better, and some of the larger firms are working overtime on substantial export orders. The demand appears to be for novel lines rather than for plain cloths.

The free trade press of the West Riding exhibited during the early days of December a state of perturbation most interesting to the onlooker, because it arose from the fact that by a considerable majority the trade unions in the wool textile industry decided to support the employers in making a further application for safeguarding. The decision was reached at a meeting of the full executives of the unions forming the National Association of Unions in the Textile Trade, held in the Textile Hall, Bradford.

An arrangement has been amicably made between the Geigy Colour Co., Ltd., and C. Roberts and Co., Ltd., of Bradford, whereby the latter firm relinquish the sale of Geigy dyestuffs in Yorkshire. As from December 31, 1928, the Geigy Colour Co. have taken over the sale of these products. Mr. Clifford Roberts has been appointed to their board of directors, and will also carry on business as a chemical merchant in Bradford.

Lancashire

THE outstanding feature in the dyestuff market during the last month has been the reduction in prices announced by Imperial Chemical Industries, Ltd. (British Dyestuffs Corporation). Dye users have long been pressing for lower prices, and the reductions notified must in many cases be very much greater than anything that could have been anticipated. The amount of the drop varies with the individual dyestuff, ranging from a penny or two to several shillings per lb. For example, Primuline is reduced from about 1s. 8d. to 1s. per lb. One brand of Methyl Violet is said to be reduced from over 9s. to 4s. 6d. per lb. All classes of colours are affected, the

reductions in the prices of the vat dyes being of the order of 10 to 15 per cent. in many cases.

Apart from these lower quotations, other advantages of a very substantial character are being offered. For example, there is a rebate of ½d. in the shilling on quantities of 2,000 lb., and correspondingly higher rebates on larger quantities. In addition, there are bonuses on invoice values.

There is naturally a good deal of uncertainty in the minds of colour users as to the policy of I.C.I. in making such substantial changes in their prices. It is believed by many that this is another step in the "rationalisation" of the Dyestuff Colour Industry. It is too early to say how far this possibility will be welcome or unwelcome to dyers and printers in Lancashire. There is, of course, a quite considerable section of the trade which favours competition.

Presumably these lower prices have been made possible by greater efficiency in organisation, processes, etc., in which case they must be regarded as evidence of greatly increased strength in the British dyestuffs industry.

Scotland

DECEMBER was a moderate month, much in keeping with the whole year, which, on looking back, has been in some ways a little disappointing, as the textile, dyeing and finishing trades, although showing some improvement in sections, have not exhibited the general improvement which was rather hoped for. The tweed industry has had a fairly prosperous year, but towards the end orders were not quite so plentiful as previously. At the moment, the majority of manufacturers are fairly busy, although repeat spring orders are not as numerous as they might be. The carpet manufacturers have been moderately successful; some competition from Southern Europe has been felt in Scotland. With the new treaty arrangements in China there should now be a considerable improvement in the Eastern textile markets. The dyeing, printing, finishing and bleaching branches have been, on the whole, fairly well employed compared with previous years.

Jute has shown a much improved year, Dundee obtaining considerable business from North and South America which normally goes to Calcutta. Linen, however, has been even more disappointing than usual, exports in some months being at unprecedented low levels. Another attempt to obtain safeguarding will probably be made during the year.

Dyestuff sales have remained fairly steady with some increase in the faster colours, and some reduction in prices.

No understanding has yet been reached on the wages question in the dyeing and bleaching trades. The date for the new wage list has been postponed from January 1 to February 1, to allow further time for discussion.

I.G. Capital Issue Unsuccessful

The Times states that the recent issue of capital by the I.G. Farbenindustrie A.-G., by which the subscription of Rm. 30,000,000 (£1,500,000) additional variable-interest bond capital was contemplated, was not successful, this being the first occasion on which the company has failed to raise money as required. Of the amount, Rm. 10,000,000 was subscribed firm by a consortium of banks, which was granted an option on a further Rm. 20,000,000 capital, but it is now reported from Frankfurt that, while the amount taken by the consortium has been disposed of, and also some proportion of the capital under option, heavy selling of the existing bonds at about the time of the issue made it apparently necessary for the consortium to take up more bonds in supporting the market than it was possible for them to dispose of out of the option capital. The issue basis was 145 per cent., this comparing with a price then prevailing of 148 per cent., but following the launching of the issue there was a fall in the bonds to 2 points under the issue price. The failure to complete the issue successfully is attributed, according to the Frankfurt financial correspondent of *The Times*, to unsuitable handling of the issue from a market point of view, a fall in the company's shares at the time of the issue, and general unsettlement of the German bourses in reflection of New York.

Dyestuffs Monthly Supplement

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Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

The Work of the Research Associations

THE report of the Department of Scientific and Industrial Research, issued last week, contains a section devoted to the work of the industrial research associations. The colour department of the British Research Association for the Woollen and Worsted Industries has continued its work on the investigation of the fundamental factors which underlie the fading of fabrics, resulting in the determination of the laws governing the relationship of humidity to fading, temperature to fading, depth of initial colour to loss of colour during fading, and also the relationship between time of exposure and loss of colour. The apparatus in the colour department has been strengthened by the addition of a spectrophotometer, whereon a new method for the investigation of the spectrophotometric curve of dyestuffs has been developed, using only a single fibre of the dyed fabric. The fugitometer designed in the Association's laboratory has been successfully launched on the market, and it is now possible to fade patterns under standard conditions of atmosphere, temperature, and humidity. This instrument is now being taken up by the trade.

Laundry Research

IN commencing its work, the British Launderers' Research Association found an industry to which scientific knowledge had hardly been applied, except indirectly through independent investigators and through the manufacturers of such materials and appliances as detergents, machinery, and water-softening plant. Those portions of the laundering process which can be studied by the methods of chemical and physical research comprise, broadly, the washing, starching, drying and finishing treatments. The methods employed were largely of the rule-of-thumb type, and the experimental and educational work of the Association has been directed towards the elimination of such methods and the introduction of properly controlled processes.

An important part of the early work of the Association was the measurement of the changes produced in fabric by subjection to treatment in a series of laundries; cotton fabric was chosen, since it represents at least 80 per cent. of laundry work, and also serves to a considerable extent to indicate the behaviour of linen. The tint of the cloths after 20 and 40 launderings, the amount of loading with mineral salts and metallic soaps, and any degree of over-bleaching, were estimated, as were also any loss of fibre or of strength. As part of the work, a simple form of tintometer was developed by means of which the tint of the fabric could be recorded. Investigations of this kind gave much information relating to the effects of the materials, the plant, and the process employed, and were followed up by laboratory work upon the properties of detergents, including soap, sodium carbonate, sodium silicate, and other substances, used either alone or two or more in conjunction. The use of various impure, hard, and softened waters was investigated, and reports have been published dealing with the various processes of softening water, from the launderer's point of view.

Effect of Washing and Bleaching

THE breakdown—a treatment with water preliminary to washing—has been studied: laundry bleaching—essentially a treatment of stained, white (undyed) goods with hot, very dilute sodium hypochlorite solution—has been carefully worked out: rinsing—a process of dilution during which no precipitation may be allowed to take place—has been examined, both in the laboratory and in the laundries of members. The investigational work has now advanced sufficiently far to render it possible to formulate washing and other processes in a manner capable of ready application by an employee who is willing to work to a reasonable series of instructions.

The problem of the fastness to washing and bleaching of dyestuffs, in relation to the fastness of dirt particles and stains, has received some attention, and the position has been summarised in a report upon the fastness of dyed fabrics to laundering.

The use of ozone and of other bleaching materials, the washing of coloured articles, the washing and bleaching of woollen goods, starching by the cold and the boiled starch processes, and laundry finishing processes in general are now under investigation, and work upon all of these subjects is well advanced.

Food Research

THE work of the British Food Manufacturers' Research Association has included an investigation of the colouring of anchovy paste. In the past this product has generally been coloured with a small proportion of bole armenia, which, as used for this purpose, is a highly purified form of oxide of iron. The use of this substance is still permissible in this country, but in certain countries its addition to foodstuffs is prohibited. In these countries only a very limited number of colouring matters are permitted, and these are not the most satisfactory from the manufacturer's point of view. Attempts were made, therefore, by the Association, to find a natural colouring matter which would give satisfactory results in the manufacture of this product. It was found that none of these were suitable, but a method of using one of the dyestuffs, permitted in most countries, was found which gives reasonably good results. This has not yet been tried out on the large scale to a sufficient extent to prove its value to the trade.

Action of Sunlight on Cotton

THE Fabrics Co-ordinating Research Committee of the Department of Scientific and Industrial Research has continued its work (at the National Physical Laboratory) on the action of sunlight on cotton. In this connection it was explained in last year's report, that some observations were to be made on the distribution of destructive power in the spectrum; the extent of deterioration being measured by the "cuprammonium viscosity" method. Observations are now in progress on samples exposed to a quartz-mercury arc. Further work is also being undertaken on the determination of the products of the decay and on the effect of absence or presence of moisture. Evidence obtained during the course of the work appears to support the view that the presence of iron compounds in cotton

serves to accelerate deterioration on exposure. This evidence conflicts with the observations of other workers, and accordingly it is being more fully examined since the point is one of considerable practical importance.

Dyestuff Licences for January

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during January has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 616, of which 532 were from merchants or importers. To these should be added 4 cases outstanding on December 31, 1928, making a total for the month of 620. These were dealt with as follows:—Granted, 581 (of which 570 were dealt with within 7 days of receipt); referred to British makers of similar products, 22 (of which 19 were dealt with within 7 days of receipt); outstanding on January 31, 17. Of the total of 620 applications received, 589, or 95 per cent., were dealt with within 7 days of receipt.

I.C.I. Dyestuff Developments

Great interest has been aroused by a statement made by the Mayor of Huddersfield, at the annual meeting of the Huddersfield Chamber of Commerce, with regard to the development of the British Dyestuffs Corporation branch of Imperial Chemical Industries. He said that I.C.I. intended to spend £300,000 on the B.D.C. works at Dalton, near Huddersfield, and that the resulting extensions would provide employment for another 1,000 workers. The company has not, so far, made any official reference to the matter. If the facts are as stated, the impending developments are clearly of the very greatest importance. The consolidation effected in the B.D.C. works of recent years has greatly increased their strength and efficiency. In view of the knowledge and experience gained, the expenditure of a sum such as that named would give I.C.I. a very strong position indeed in the dyestuff markets of the world.

The Silk and Rayon Guide

The firm of John Heywood, Ltd., of Manchester, have just issued the 1929 edition of their well-known annual publication, *The Silk and Rayon (Artificial Silk) Directory and Buyers' Guide of Great Britain*, including artificial silk producers of the world (pp. 386, 21s.). Included in this volume are, among other things, a glossary of artificial silk terms; a list of trade associations, etc.; a list of artificial silk producers of the world; trade names of silk and rayon yarns, fabric, etc.; classification in towns of manufacturers, spinners, dyers, agents, engineer's, etc.; buyers' guides, and so on. The list of artificial silk producers, though only a minor feature of such a large book, is a model of its kind. The names are classified under the headings of their respective countries, and the entries include types of artificial silk produced, capitalisation, output, directorate, etc.

World's Artificial Silk Producers

The classified list of artificial silk producers, actual and potential, under national headings, works out as follows: Austria, 2; Belgium, 13; Brazil, 1; Canada, 2; Czechoslovakia, 4; England and Scotland, 36; France, 36; Germany, 22; Greece, 1; Holland, 2; Hungary, 2; Ireland, 1; Italy, 15; Japan, 9; Nova Scotia, 1; Poland, 3; Russia, 2; Spain, 7; Sweden, 1; Switzerland, 8; United States, 27. Many of the companies are newly formed, and not yet actually working on the large scale. The industry is, as is well-known, the subject of various international understandings. In addition, it

may be mentioned that several of the French producers work in conjunction through the Comptoir des Textiles, which is the selling organisation for their products; about half the German output is controlled by the Vereinigte Glanzstoff Fabriken, through its association with various other companies; and four Italian companies are associated with one another.

A Society of Arts Lecture

In view of the fame achieved by the products of Scottish Dyes, Ltd., great interest will be taken in a lecture on the "History of the Development of Fast Dyeing of Dyes," which is to be delivered by Mr. James Morton to the Royal Society of Arts, at its rooms in John Street, Adelphi, London, on Wednesday, February 20, at 8 p.m. Professor H. E. Armstrong, F.R.S., will take the chair.

Bamboo for Artificial Silk

For some years past the use of bamboo as a raw material for various purposes, including the production of artificial silk, has been the subject of a good deal of research. Dr. Nanji, of Birmingham University, has especially concerned himself with the investigation of this material. It is now announced that a company has been formed to adopt an agreement with Dr. Nanji, and interesting industrial developments may be expected. One of the most striking points about bamboo is its rapid growth, and the successful large-scale application of the material may have economic results of a most important kind.

U.S. Dyestuff Industry and Tariffs

The dyestuff manufacturers of the United States are agitating for higher tariffs on imported dyestuffs. Various reasons are given for the demand. The key position of the synthetic organic chemical industry is emphasised, as is also the power of foreign competitors, organised into strong cartels. Special importance is attached to the development of fast dyes, and it is pointed out that the prices of home-produced fast dyes can be reduced, and the demand for them therefore stimulated, if the domestic dyestuff industry of the United States is assured of a minimum of competition from abroad. During the hearing of the claim before the Committee of Ways and Means, it was stated that the United States only produces about 25 per cent. of the different varieties of dyestuffs used in the country, but that the percentage in question is over 90 per cent. of the total quantity of dyes used.

No official decision has yet been made in the matter, but it would not, of course, be at all surprising if the agitation resulted in the higher tariffs demanded. The points made with regard to fast dyestuffs are very interesting. A large amount of very important research on dye fastness is now being carried out in America, and public interest in the matter seems to be higher in that country than almost anywhere else.

The Denierometer

The Richard Denierometer, a new instrument for obtaining the denier of all varieties of textile yarns, even in very short lengths, is being produced by the Société Anonyme des Etablissements Jules Richard, manufacturers of scientific instruments, in Paris. It was developed by the Société Chimique des Usines du Rhone, an associate of La Société pour la Fabrication de la Soie "Rhodiaseta," manufacturers of "Rhodiaseta" brand acetate silk, in order to study the regularity of denier of Rhodiaseta silk, and is, therefore, particularly adapted for use on rayon and true silk. This instrument is said to be very rapid, accurate, and convenient for obtaining the denier of short lengths of any type of yarn, and for comparing the denier of each portion of the yarn with every other portion.

The Standardisation of Tests for Fastness to Light

Work of the American Association of Textile Chemists and Colourists

At a recent meeting of the American Association of Textile Chemists and Colourists, Dr. W. D. Appel, of the United States Bureau of Standards, summarised the work done by the research committee of the Association on the standardisation of tests for fastness to light. The main points of the report (published in extenso in the "American Dyestuff Reporter") are given below.

THE report dealt first with the question of daylight exposure tests. When a series of dyeings was exposed to sunlight, said Mr. Appel, the dyeings faded more or less, relative to one another, depending on their nature and the conditions of exposure. Rather surprising results might be obtained.

Identical sets of dyeings exposed on a roof at the Bureau of Standards in Washington, one facing north and the other south for eleven days and nights last summer faded as follows: Nine samples out of twenty tested faded to the same extent in the north window as in the south, three faded slightly more facing south, six materially more facing south, and two slightly more facing north. Although those two dyeings received less light facing north they faded a little more than they did facing south. The rate of fading of the dyeings was obviously dependent on the nature of the dyeings and environmental conditions, as well as on the amount of light. This had been checked further with the aid of a barium photo-electric cell for recording the light.

A whole series of tests was run by the committee to show the influence of glass cover or no glass cover over the dyeings, of free access of air or lack of it, of the angle of exposure, the difference in fading action between sunny sky and cloudy sky, north light and south, continuous exposure day and night regardless of the weather, and exposure to sun and clear sky only. All of these conditions had an influence on the relative fading of dyeings in a series and therefore on the relative merits of the individual dyeings for practical use.

A Standard Daylight Exposure Test

The results showed that individual dyeings behaved differently under different conditions of ordinary daylight exposure, and before a laboratory accelerated fading test of any practical value could be established the type of daylight exposure which it was hoped to reproduce in the test must be selected.

The committee had found one type of daylight exposure which would give fairly reproducible results over the better part of the year and in different parts of the United States; namely, exposure between 9 a.m. and 3 p.m. on clear days, samples to be placed at an angle of 45° with the horizontal, facing south, and protected by window glass $\frac{1}{4}$ -inch thick, the glass to be raised $\frac{1}{2}$ -inch above the samples and provision made for free access of air. This had been selected by the committee as its "standard" sun exposure test and recommended for general use wherever a definite reproducible daylight test, having minimum environmental complications and maximum light effect, was required, something to use as a control on the laboratory test and in cases of dispute, though perhaps for routine testing.

Factors Which Influence Results of Exposures

Before speaking of accelerated tests, it might be worth while to mention some factors which were responsible for the variable behaviour in daylight exposures.

Atmospheric humidity had long been recognised to be an important factor. Controlled laboratory experiments showed that some dyeings faded three times faster in air of high humidity than in low. Other atmospheric influences had been noted such as those of acid or alkaline vapours. Temperature might have an effect but probably it was not a large one and evidence was lacking.

The special distribution of the radiation was obviously important because only radiation which was absorbed could produce fading and dyeings showed selective absorption, i.e., one dyeing absorbed in one part of the spectrum, another in another part. The committee had obtained some information on this phase of the subject by exposing a series of dyeings under glasses having suitable spectral transmissions.

The importance of the ultra-violet radiation which passed through window glass as well as the blue and violet regions of the visible spectrum was clearly demonstrated in the tests made by the committee, and it was true that some dyeings were particularly sensitive to that part of the solar radiation which was absorbed by window glass. The deficiency of

solar radiation in this last-mentioned region should be borne in mind. Not only was it very small in amount but it was extremely variable and at times entirely lacking. That should be borne in mind. The effectiveness of this region for fading should not be exaggerated and should not be confused with its bactericidal and therapeutic importance, which had been very much stressed recently. The committee could not see the necessity for using a special glass like Vita for exposure tests as the British had done.

The intensity of the radiation as well as its spectral distribution was an important factor. Gebhardt observed in 1914 that light of a given spectral distribution must have a definite intensity before it could cause fading and that this "threshold" value was specific for each dye. If drapery hung in a dimly lit room or a north window, it might not fade even though it would fade in an ordinary sun test.

The fading of dyeings in use was influenced by a number of independent variable factors. Individual dyeings behaved differently with respect to these factors. Incidentally, the ultra-violet in sunlight which was transmitted by window glass played a relatively small part in dye fading in everyday conditions.

Sources of Illumination

Although the final criterion of the fastness to light of a dyed fabric was the daylight exposure test, the need for an accelerated test was apparent. The quartz mercury light, "the light that fades," without a doubt produced entirely different fading from sunlight, though if the dyeings were protected from the short wavelength ultra-violet not present in sunlight, results were obtained which were rather remarkable in view of the discontinuity of the radiation.

The 1,000-watt gas-filled Mazda lamp had given encouraging results as a source of light, but in order to get the necessary intensity at the violet end of the spectrum much larger lamps would be required. This greatly increased the cost and the difficulty of removing the excessive heat radiation. For the present the idea seemed to be impracticable. The point-light, tungsten arc similarly did not appear to be a practicable source in its present development.

The enclosed carbon arc lamp was perhaps the most useful source now available, and it was used rather extensively in the dye and textile industry. It gave results which agreed reasonably well with sun exposure, though some samples faded too much and others too little when exposed to this source in the usual way. The British Research Association for the Woollen and Worsted Industries had devised an outfit using this light in which a lower temperature and higher humidity at the samples were maintained, and this gave somewhat better results. The possibilities for improving the carbon arc lamp for this purpose had not been exhausted.

Proposed Standardisation Plan

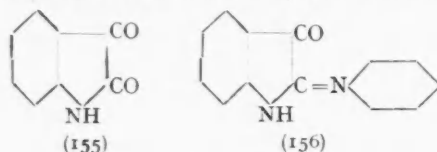
It was evident that no one standard light and set of exposure conditions would tell the whole story of how dyeings would behave in use. Some people would be satisfied with the results of carbon arc tests, others with those of the standard sun exposure test, while still others would be satisfied only with continuous daylight exposure tests even though they might not be capable of duplication. One way to overcome this difficulty would be to test under two conditions or to work out a cycle of conditions such as that used by progressive paint-testing laboratories. That was for future development.

For the present, at least, the practical solution of the problem appeared to lie in the adoption of a set of standards of fastness with which everyone could compare his samples. The Association had undertaken to prepare and distribute at a nominal fee sets of dyeings representing the different recognized degrees of fastness to light. Thus, instead of designating dyestuffs to be dyed by the tester—the practice of the German and British associations—pieces of cloth of known fastness would be used as standards, and anyone might test against the same identical standards and express fastness in terms of them.

Basic Intermediates for Dyestuffs: XXV.—Isatin and Its Derivatives

By "Consultant"

THERE are a number of derivatives of isatin which are in considerable demand for the preparation of the indigos and semithioindigos. The value of isatin derivatives lies in the fact that they will condense, through one of their carbonyl groups (see formula 155), with the active methylene groups of various compounds such as indoxyl and thioindoxyl and



their derivatives. Examples of such condensations are given later. Isatin itself (155) is prepared through its anilide (156), for the preparation of which thiocarbanilide is the most convenient intermediate. It is possible, of course, to obtain isatin by the oxidation of indigo, but the yield is poor and the method obviously inadmissible in the synthetic dyestuff industry.

Thiocarbanilide

The preparation of thiocarbanilide (157) is a simple and quantitative operation which is effected by the condensation of aniline and carbon bisulphide. The aniline is mixed with an excess (twice its weight) of carbon bisulphide in a large enamel digester fitted with a closed cover and ventilation hood, and also with adequate reflux condensing arrangement for dealing with the vapour of carbon bisulphide. The interaction of carbon bisulphide and aniline is comparatively slow at ordinary temperatures, and can be hastened by warming and by the presence of caustic alkalies. The vessel is therefore warmed gently so that the carbon bisulphide refluxes fairly rapidly, and caustic soda to the extent of about one-tenth the weight of the aniline is added as a "catalyst." After the reaction once sets in it usually proceeds with the evolution of so much heat that the aid of artificial heating may be dispensed with. Stirring must be continued throughout the whole of the condensation. If it is stopped during night shift the masses of crystals which accumulate round the paddles make it very difficult to start again. In addition, there is grave risk that in dislodging these crystals (one such case is on record), the liquid which has become super-heated during the night will boil over suddenly, with the danger of fire or "gassing" of employees.

When the condensation has been completed (about two days) the excess of carbon bisulphide is distilled off and the residue ground with dilute hydrochloric acid until free from aniline. The washed and dried powder is then further milled to dust fineness, after which it is ready for the synthesis of isatinanilide.

Isatinanilide

The first operation consists in the formation of hydrocyanocarboxyphenylimide (159), by treatment of a suspension of thiocarbanilide with lead carbonate and sodium cyanide; but this step involves two chemical reactions, firstly, the removal of hydrogen sulphide from the thiocarbanilide with the formation of diphenylcarbodi-imide (158), and secondly

the addition of hydrogen cyanide to this compound giving hydrocyanocarboxyphenylimide.

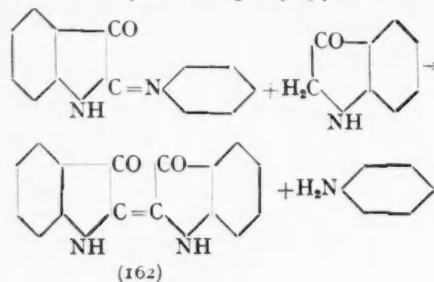
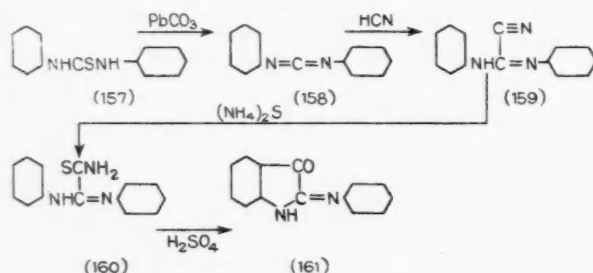
The operation is carried out as follows:—The sodium cyanide (100 per cent., $\frac{1}{2}$ cwt.) is dissolved in water (20 gallons), and made into a paste with basic lead carbonate ($2\frac{1}{2}$ cwt.). A mixture of dust-fine thiocarbanilide (2 cwt.) is added, together with 50 gallons of 90 per cent. alcohol. The mixture is stirred vigorously and heated gently to 50–60° C. until the filtrate no longer yields a black coloration with lead carbonate on boiling (indicating the absence of free thiocarbanilide). Stirring is continued for a further period of four hours, after which the liquid is filtered hot and the residue extracted with waste alcohol. On cooling, the hydrocyano-compound separates out.

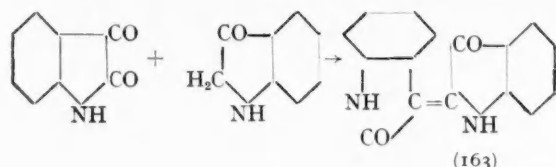
The next stage in the operations consists of the addition of hydrogen sulphide to the -CN group of the previously prepared compound. This gives thio-oxamidediphenylamide (160). The reagent which brings about this change is yellow ammonium sulphide. Ammonia solution (20 per cent., 40 gallons) is placed in an enamelled digester and saturated with hydrogen sulphide. When saturated, ground sulphur is added (25 lb.), and the solution kept at 30° C. until solution of the sulphur is complete. To this solution, vigorously stirred, is added the finely powdered hydrocyanocarboxyphenylimide (2 cwt.), and the whole stirred together at 30–35° C. for two days, or until such time as a sample dissolves completely in dilute hydrochloric acid (indicating absence of unchanged cyano-compound). The thio-oxamidediphenylamide is obtained as a lemon yellow powder which can be filtered off and washed.

It is converted into isatinanilide by the action of concentrated sulphuric acid. The acid (98 per cent., 4 cwt.) is heated in a vessel with a closed lid and a duct to remove fumes. When the temperature has reached 90° C., the thio-oxamide derivative (1 cwt.) is added slowly so that the temperature does not rise above 95° C. This temperature limit is important, since further heating destroys the product at this stage; later, when all the sulphur dioxide has been evolved, the temperature is raised to 105–110° C., until the last traces of sulphur dioxide have been removed. The mixture is cooled somewhat, and poured on to crushed ice. A mixture of isatin anilide and sulphur is precipitated. The sulphur is removed by treatment with carbon bisulphide, and the residue of isatinanilide recrystallised from spirit.

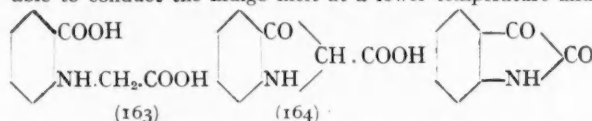
Condensations of Isatinanilide

Isatinanilide can be condensed with nearly all the substances which will condense with isatin itself, but in the case of the anilide the condensation takes place through the α -carbon atom, whereas with isatin the condensation almost invariably takes place through the β -carbon atom. A case in point is the condensation with indoxyl. With isatinanilide ordinary indigo is formed (162), whereas with isatin itself the condensation takes place through the β -carbon atom with the formation of indirubin (163). The most useful condensation shown by isatinanilide is that with the thionaphthenes, which resemble indoxyl in their reactions. It may be added that this synthesis of indigo, although feasible commercially, cannot compete economically with the phenyl-glycine melt.



**Isatin**

Isatin itself, which forms red prisms of m.p. 200–201° C., can be obtained from the anilide by boiling with dilute mineral acids. An alternative method for the preparation is to add an oxidising agent to the indigo melt; it is, however, preferable to conduct the indigo melt at a lower temperature and

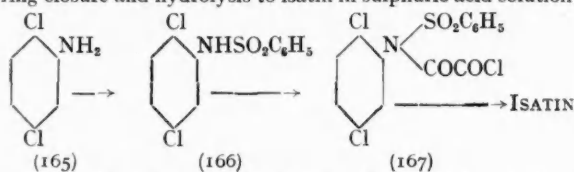


isolate the first condensation product of phenylglycine- α -carboxylic acid (163), namely, indoxyl acid (164). This can be converted into isatin as follows:—The indoxyl acid (14 lb.) is suspended in water (10 gallons) in which caustic soda (20 lb.) has been dissolved. The solution is warmed to 60° C., and potassium permanganate gradually added (12 lb.), so that the temperature does not rise above 80° C. In this way, the indoxyl acid is oxidised to isatin. The hot solution is filtered from the manganese mud, made faintly acid and allowed to cool. Isatin separates as dull red crystals. Isatin, as has already been mentioned, will condense with indoxyl and thioindoxyl, giving in the latter case Thioindigo Scarlet R. The corresponding compound from isatinanilide has been used under the name of Ciba Violet.

Substituted Isatins

The reactions already mentioned for the preparation of isatin are fairly general; given the necessary thiourea it is comparatively easy to obtain the corresponding isatin. Thus from ditolylthiourea a methylisatin is obtained, but with halogenated isatins the thiourea (e.g. *s*-dibromodiphenylthiourea) is not easy to obtain. It happens that the bromination of isatin gives the 5:7-dibromo-compound directly, and this is used in the preparation of brown dyes with naphthioindoxyl.

A more recent synthesis of substituted isatins does not employ the thiourea. The amine, as for example 2:5-dichloraniline (165) is treated with benzenesulphonic chloride to give the intermediate compound (166). Oxalyl chloride then gives the derivative (167), which suffers simultaneous ring closure and hydrolysis to isatin in sulphuric acid solution:



By treatment of isatin in ligroin with phosphorus pentachloride isatin chloride can be obtained, which will condense in the α -position; it is not, however, very widely used.

Wool Safeguarding Inquiry**Proceedings Begun**

A COMMITTEE, consisting of Sir Hubert Llewellyn Smith (chairman), Mr. G. N. Barnes, and Mr. F. R. Davenport, began an inquiry on Monday into an application by the Bradford and District Manufacturers' Federation, the Keighley and District Manufacturers' Federation, and the Textile Commission Manufacturers' Association under the Safeguarding of Industries Act for an import duty on all dyed or undyed imported tissues or fabrics manufactured from warp and weft in a weaving loom (whether in the piece or in any other form) and made wholly or partly from wool or hair, of any weight from 2 ounces per square yard up to and including 11 ounces per square yard, but excluding felts, rags and tailors' clippings. Mr. Cyril Atkinson and Mr. Macaskie appeared for the applicants; Mr. A. S. Comyns Carr and Mr. C. F. Entwistle opposed

the application on behalf of a group of British manufacturers and merchants.

At the continuation of the inquiry on Tuesday, the chairman, on a point raised by Mr. Comyns Carr, stated that the committee were unanimously of the opinion that the reference before them was solely in respect of import duties on certain specified categories of woven tissues and fabrics, and the words, "Whether in the piece or in any other form," did not extend the reference to cover safeguarding duties on made up and manufactured articles into which the tissues and fabrics might have entered.

Fabrics and Ultra-Violet Light**Bureau of Standards Report on Transmission**

THE United States Bureau of Standards has investigated the transmission of ultra-violet light by various fabrics. The report of the Bureau gives the following results:—

It is well recognised that the short wavelength ultra-violet rays in sunlight exercise a strong effect in restoring the human body to health, and recently considerable attention has been given to this subject from the standpoint of sales promotion of special kinds of wearing apparel on the supposition that they are especially transparent to ultra-violet radiation. In view of the numerous inquiries regarding the accuracy of such claims the Bureau of Standards undertook a quantitative determination of the amount of ultra-violet radiation transmitted by fabrics made from various kinds of thread; cotton, silk, wool, linen and artificial silk.

Close and Open Weaving

Measurements were made on close-weave and open-weave cloth. White and black samples of the same weave (e.g., satin, twill, voile) were examined; the black to determine the amount transmitted through the openings between the threads and the white material to determine the amount transmitted through the threads. The results of the research demonstrate very clearly the importance of using bleached white material in order to obtain a high transmission of ultra-violet rays through the thread. A slight yellowing of the natural silk, or the yellow colour of unbleached cotton, greatly reduces the transparency to the ultra-violet. Likewise most of the dyes in common use reduce the ultra-violet transparency. Hence, as is to be expected, comparing dyed fabrics, the one having an open weave transmits the most ultra-violet, irrespective of the composition of the thread. It is found that white cotton and viscose artificial silk (which substances are practically pure cellulose), linen, and cellulose acetate rayon are the most transparent to ultra-violet rays. Natural silk not yellowed with age stands a close second.

Mercerisation Patent Action**Case Dismissed**

IN the Chancery Division, on Wednesday, February 6, Mr. Justice Clauson delivered his reserved judgment in the action brought by Samuel Heap and Son, Ltd., Caldershaw Mills, Rochdale, Lancs, against the Bradford Dyers' Association, to restrain an alleged infringement of their patented process for the mercerisation in the piece of mixed fabrics containing artificial silk without damaging the silk. The defendants denied infringement, and challenged the validity of the patent on the grounds of common knowledge and lack of subject matter.

His Lordship said that the patentee in 1922 took out a patent for the application of an old and well-known mercerisation process to a mixed fabric of cotton and cellulose-acetate silk, he having discovered that the process had no deleterious effect on the silk, and the question was whether the plaintiffs' specification disclosed a new manufacture. Having regard to the evidence in the case, his Lordship said he could not see how the application without modification to cotton in a mixed fabric, plus an auxiliary material of the old mercerisation process, could constitute a new manufacture.

If the patentee had discovered that some modification was required, it would, of course, have been different. He was not impressed with the argument that the alleged discovery constituted a new manufacture. He held that the patent was void for the want of subject matter, and dismissed the action, with costs.

Dyes and Their Application: Recent Technical Progress Technical Developments in 1928.—(II)

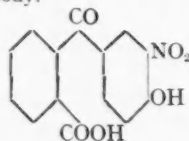
By L. J. Hooley

In the following article Mr. Hooley completes a review of the advances which took place in the dyestuff and allied industries in 1928. The first part of the review appeared in last month's issue of this supplement.

Anthraquinone

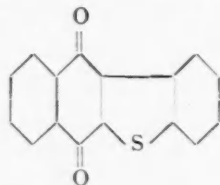
THIS branch contains some of the most interesting work of the year, contributions having been made by British, American and foreign manufacturers. The work is extremely varied, dealing with the production of intermediates, with the investigation round both wool and vat dyestuffs already known to be valuable for the purpose of obtaining similar compounds of commercial utility, and with the investigation of entirely new products. Only the main outlines can be mentioned. As has been previously stated this division is only exceeded in bulk by the combined classes of azo colours.

Dealing first with intermediates, the Newport Co. have protected a number of benzoylbenzoic acids. The position with regard to the production of anthraquinone has always been different in America, where the synthetic method from phthalic anhydride is of much more importance. The benzoylbenzoic acid derivatives are mostly amino-, nitro- and hydroxy- ones. As an example 3^l-nitro-4^l-hydroxy-*o*-benzoylbenzoic acid may be mentioned, obtained from the corresponding chlor body.



1:4-dimethyldiaminoanthraquinones may be treated with sulphuric acid to remove one or both of the alkyl groups (291,814, B.D.C., A. Shepherdson, W. W. Tatum and F. Lodge); or with oleum to obtain sulphonic acids (B.P. 294,672, S.D.L., J. Thomas and L. J. Hooley). Alizarine can, somewhat surprisingly, be obtained from 2-methylanthraquinone by caustic fusion (B.P. 293,228, S.D.L., J. Thomas and H. W. Hereward). Brass and Albrecht (*Ber.*, 1928, 983) describe the preparation and properties of the anthraquinone diazides; these are obtained from the diazonium perbromides, and decompose to aminohydroxy and other derivatives.

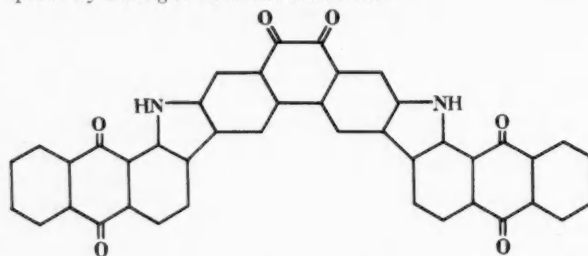
Investigation of the anthraquinone thiomorpholines and thioethers suitable for use both as acetyl silk and acid wool colours continues. Reference may be made to B.P. 263,179, 263,178, and 263,795 (I.G.F.A.-G.). Further dyestuffs similar to the Alizarine Sky Blue type have been produced from anthraquinone-1-amino-4-brom-2-sulphonic acid, various amino derivatives being used for the substitution of the bromine atom. Two interesting syntheses of derivatives analogous to anthraquinone are to be found, firstly, in B.P. 261,393, where benzene is condensed with thionaphthene-2:3-dicarboxylic anhydride in the presence of aluminium chloride, the resulting carboxylic acid being ring closed with sulphuric acid.



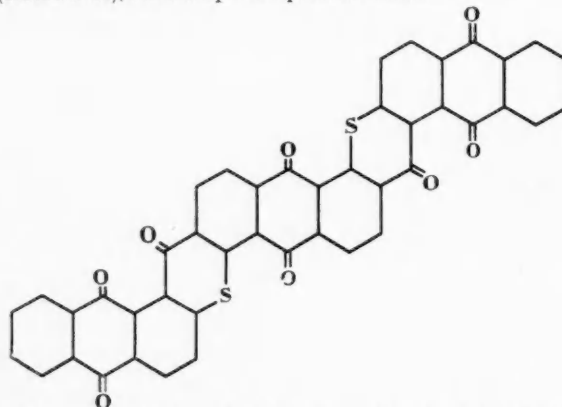
In B.P. 265,393, the same compound is obtained from thionaphthene and phthalic anhydride. Treatment with glycerine gives a benzanthrone.

In B.P. 281,188 (B.D.C., J. Baddiley, P. Dootson, A. Shepherdson, and S. Thornley), aminoflavanthrones are condensed with halogenated anthraquinones, pyranthrones, etc., to give browns. In B.P. 282,852 and 282,913 (B.D.C., S. Thornley and A. Shepherdson), flavanthrones and pyranthrones are treated with hydroxylamine to give green or

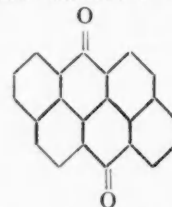
brown vat dyes respectively, which may be made faster to alkali by acylation. Two other applications, B.P. 282,481 and 278,102 by the B.D.C., deal also with pyranthrone derivatives. Phenanthraquinone is mentioned in B.P. 278,771, where 1-aminoanthraquinone is condensed with 2:7-dibromophenanthraquinone and the resulting product further treated with aluminium chloride to give a reddish brown vat dye probably having the constitution shown.



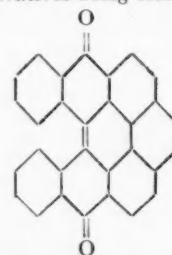
Anthraquinone thioxanthenes are obtained in B.P. 294,098 (I.G.F.A.-G.), for example the product shown.



New methods of synthesising the anthanthrones and their derivatives have been described. To the already known



benzdianthrone and naphthodianthrone a new *Tallomeso*-naphthodianthrone and an anthradianthrone have been added, these and their derivatives being orange to red dyestuffs.



allomesonaphthodianthrone.

In B.P. 290,309, the use of anthraquinone vat dyestuffs for obtaining fast colouration of cement and concrete is described (S.D.L., G. N. White, J. Thomas, E. G. Beckett).

Perylene Derivatives

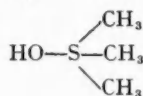
Kalle and Co. (G.P. 441,587) halogenate tetracarboxylic acid di-imide in chlorosulphonic acid. Some further diacyl and diaroyl derivatives and chlorperylenequinones have been made by Bensa and by Pongratz.

Cerbellini and Aymar have compared the yields in different methods of making perylene (*Giorn. Chim. Ind. Appl.*, 1928, 10, 196-199).

Application

Very diverse applications for solubilising and wetting-out agents are found in the retting of flax, the decolorisation of syrups with silica gel, the manufacture of inks, aerated waters, paints and distempers (B.P. 278,485, 279,583, 279,968, 280,302, 285,929, B.D.C., C. Hollins, E. Chapman and A. Shepherdson). Mineral oil fractions such as the residues after treating Borneo petroleum with liquid sulphur dioxide may be sulphonated to give wetting agents (B.P. 279,990, B.D.C., J. Baddiley and E. Chapman). The oxidation of sulphite cellulose waste liquor increases its dispersing and solubilising properties (B.P. 290,532, B.D.C., J. Baddiley and A. J. Hailwood).

Rath has described the properties and uses of the Nekals, Leonils and other wetting agents (*J.S.D.C.*, 1928, 41). For preserving dyes in finely divided condition cellulose ethers are recommended (I.G.F.A.-G., B.P. 269,918). The alkyl sulphonium hydroxides—e.g., trimethyl sulphonium hydroxide,



may be used in mercerising, replacing caustic soda, with improvement in the strength and appearance of the material. They may also be used instead of alkali in the xanthogenate silk process (B.P. 281,117, 281,473, B.D.C. and A. J. Hailwood).

Production of Pattern Effects

The production of pattern effects other than by printing and the weaving of already dyed yarns, is receiving increasing attention. The weaving of mixed undyed yarns is one of the most frequent and widely used of these devices. These materials offer greater elasticity, and mean the carrying of smaller stocks. A small dyer has to some extent the resources of the weaver. An already woven mixed fabric can be dyed at a few hours' notice to any colour submitted, while to get the same effect by dyeing in the yarn is much less convenient.

In B.P. 268,339 (Heberlein and Co.) fabric containing acetyl silk is passed through heated embossing rollers and then mercerised, the pressed parts being less affected by the mercerisation. Localised dipping is resorted to in U.S.P. 1,655,973 (R. R. Ross), and floating the dye on the surface of the liquor in U.S.P. 1,668,934.

Affinity of dyes for animal fibres is increased by treating the latter with ozone and an oxygen-containing substance (B.P. 289,578, S. W. Wilkinson). Acid wool dyeings are made faster to washing and milling by after-treating with nitrous acid (G.P. 440,606, I.G.F.A.-G.). Oleic acid improves the brightness of dyed silk in the usual potash-olive oil treatment (*Kunstseide*, 9, 517, K. Wolfgang).

Reinking continues his interesting summary of the oldest literature of the printing trade in *Melliand Textilb.* (1928, 582). Improvements in steaming apparatus are described in U.S.P. 1,633,845 (Deltex Co. and R. W. Jacoby) and in B.P. 282,133 (S.D.L., J. S. Wilson, G. W. Shearer, J. Thomas).

An Aniline Black which is ungreenable is obtained without after-chroming by giving a dry heat treatment (110-180° C. for 5-45 sec.) before steaming (B.P. 279, 164, C.P.A., L. A. Lantz, R. Wilson). Glycols containing 3-5 carbon atoms are used as solvents in printing pastes (B.P. 292,441, Bleachers' Assoc., R. Gaunt, C. L. Wall).

C. M. Keyworth has determined the constitution of various reserve salts (*J.S.D.C.*, 1928, 177).

Intermediates

Unsubstituted hydrocarbons, for example, ethylenes, are converted to benzenes by first passing them at about 40

atmospheres and 400° C. over a hot catalyst, and then dehydrogenating the hydrocarbons formed with a molybdenum catalyst at 600° (B.P. 261,393, I.G.F.A.-G.).

Carbazole is purified from naphthalene and anthracene by treatment with warm carbon tetrachloride (U.S.P. 1,672,630, C. J. Thatcher). Work has been carried out by the Department of Scientific and Industrial Research on fluorene, acenaphthene and perylene derivatives. Considerable attention is being devoted at the present time to the production of hydrocarbons and other derivatives by vapour-phase catalytic processes. In B.P. 268,775, alternate catalytic oxidation and decarboxylation are used; naphthalene may be converted in this way to maleic anhydride. Cyclic compounds are degraded by passage at about 300° C. with hydrogen over a dehydrogenating catalyst; for example, benzene and aniline may be obtained from carbazole. The process is of potential interest for impure mixtures of complex hydrocarbons.

Benzene Derivatives

Two or three processes for obtaining benzoic acid from phthalic acid have been described, B.P. 262,101, 291,326 (I.G.F.A.-G.), U.S.P. 1,645,180 (Conover). The valuable resins obtained from phthalic anhydride and glycerol are meeting with increasing attention as a result of their excellent properties for electrical purposes. U.S.P. 1,663,183 recommends a slow treatment at a low temperature in the production of these resins, to get colourless products. Various patents deal with the preparation and regeneration of catalysts, as well as with methods and apparatus for controlling temperature and other conditions.

Semeria and Millone (*Annali Chim. Appl.*, 1928, 68) discuss the reduction of nitrobenzene to aniline with hydrogen, using a copper or silver catalyst. *m*-Dinitro-benzene is separated from the *o*- and *p*-isomers by treatment with alkaline substances which dissolve the latter (U.S.P. 1,665,005, Newport, H. J. Weiland and I. Gublemann).

The preparation of benzoic anhydride and its utilisation for benzoylation have been described by the B.D.C. (B.P. 280,373, J. P. Payman, N. Hall). Further poly-substituted benzene derivatives, containing especially amino-, chloro-, methyl- and sulphonic acid groups, for the production of indigo, azo and other dyes, have appeared during the year. Phenol is obtained from chlorobenzene with steam and active silica gel at about 350° C. The addition of ammonia to 1-naphthylamine-3:6:8-trisulphonic acid is recommended in the production of "H" acid by alkali fusion (U.S.P. 1,670,476, Newport Co., I. Gublemann, J. Tinker). 2-amino-naphthol-3-carboxylic acid is obtained from the corresponding naphthol by treatment with ammonia and a ferrous salt (B.P. 282,450, I.G.F.A.-G.). Various 1:8-naphthalene derivatives are described (B.P. 276,126, I.G.F.A.-G.).

The British Dyestuffs Corporation have described the production of various highly chlorinated naphthalenes and their use in polishes, waxes, etc., suitable for applying to wood, linoleum, porcelain, paper, metallic and other surfaces, in a series of British patents, the inventors being in each case J. B. Payman and W. Gibson. Among other intermediates for which methods of preparation have been described, 6-nitro-acenaphthene and carbazole-2-carboxylic acid may be mentioned.

Phthalic anhydride is used for separating mono- and di-alkyl derivatives of aromatic amines. In B.P. 288,122, Verley alkylates aromatic compounds in the nucleus by treatment with alcohol and sulphuric acid containing alkali pyrosulphate. Thymol is thus obtained from *m*-cresol and isopropyl alcohol. Iron pentacarbonyl is recommended for reduction in D.R.P. 441,779 (I.G.F.A.-G.). Difficulties in the partial diazotisation of di- or poly-amines are overcome by first converting the amino groups to sulphaminic acids.

Dyestuffs Advisory Licensing Committee

THE Board of Trade, on the nomination of the Association of British Chemical Manufacturers, have appointed Mr. Ernest Hickson, of Hickson and Partners, Ltd., Castleford, Yorkshire, to be a member of the Dyestuffs Advisory Licensing Committee, in place of the late Mr. W. H. Dawson.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

SALES of dyestuffs have been good during the past month for all classes of colours. The Naphthol A.S. group is, perhaps, the only branch showing any important new developments, with the exception of the new vat green introduced recently by Scottish Dyes, Ltd. Representatives of the I.G. dyestuffs have been demonstrating the blue produced by combining the new Naphthol AS-E with Variamine B, which is claimed to have better fastness properties than the Hydron Blues, and a new violet is attracting attention.

It is as yet too early to say what will be the effect of the new price policy instituted by the I.C.I. So far, the reports are that all the principal colour manufacturers are quite satisfied with the position, whilst the dyer is complaining that manufacturer and merchant are demanding reductions in prices greater than the amount of his saving in dyestuff cost. Some of the larger users feel that the new terms do not give a sufficient advantage to them over the small man. It may be interesting to have the new terms set out:—

1. REBATE ON PRICE OF DYESTUFFS.

The customer contracts for each separate colour, giving an estimate of his consumption. The standard price of the colour is then reduced accordingly, by the following scale.

Cost of Colour	Consumption.	Reduction below Standard Price.
6d. to 1s.	2,000 to 5,000 lb.	¼d.
	5,000 to 10,000 lb.	½d.
1s. to 3s.	2,000 to 5,000 lb.	¼d.
	5,000 to 10,000 lb.	½d.
3s. and over.	2,000 to 5,000 lb.	1d.
	5,000 to 10,000 lb.	1½d.

If the customer's consumption falls below his estimate, so that he is not entitled to the reductions given above, a surcharge will be adjusted out of the second form of rebate at the end of the year.

2. BONUS ON CONSUMPTION.

A bonus will be paid *in kind* on the total annual consumptions, as follows:—

£5,000 worth and over	5%
£10,000 " " "	6%

Sulphur Black consumption must be 25 tons before a reduced price for quantity is given, but the cash value of any quantity of Sulphur Black is included in the turnover rebate.

There is no reduction in price on indigo for taking quantities, and there is no allowance for indigo in the turn-over rebate, except that the value of indigo taken can be counted for estimating the percentage on which the rebate should be given.

Yorkshire

Trade continues on the upward grade. January's turnovers are reported to have been bigger than those of January last year, and weights must have been much bigger, a blessing much appreciated by the smaller dyestuff firms that have not large stores of liquid assets to squander in the cutting of selling prices and can only hope to mitigate the effect of reduced prices, which last month so suddenly upset the market, by increasing output, thereby lessening the overhead charges per unit of material produced. But even that will not help in all cases, for it is believed that the newly reduced prices of some colours are without any relation to the manufacturing cost and, unless there is some ulterior motive, the reductions would appear to have been quite unnecessary.

There is a good deal of speculation in Yorkshire as to the motive, and the matter is being discussed not only by the "outside" manufacturers but by consumers also. There is a suspicion that the disappearance of "outside" concerns is

regarded as, at least, desirable, but a month of keen contest has shown that they are prepared to put up a good fight for the retention of their share of the trade and in this are not without the sympathetic support of the consumers. Further, it is said that there are signs of movement towards that union which makes for strength.

Sir Edward Brotherton, in discussing the dyestuff position in England, has pointed out that progressive reduction in prices in the last few years has only been effected by the sacrifice of the margin of profit resulting from gradual pressure on the part of the consumer.

At the annual meeting of the Huddersfield Chamber of Commerce on January 25, the Mayor of Huddersfield (Alderman T. Canby) said that he had learned that the British Dyestuffs Corporation, Ltd., intended to spend £300,000 in extending and improving their works and plant at Dalton, Huddersfield, which would mean on completion employment for 1,000 additional people. For several years past, the British Dyestuffs Corporation have been modernising their works at Dalton and concentrating them at this point, instead of having their plant scattered over a wide area ranging from Dalton to Turnbridge. It is said to be their intention this year to speed up the constructional work.

Steps are being taken for the establishment in Leeds of a low temperature carbonisation plant on a fairly large scale. It is the new industry for the city of which Sir Charles Wilson, M.P., recently gave a hint. The suggested site for the establishment of the plant is the present York Street gasworks, closed down since 1923, which it is proposed to lease or purchase from the Leeds Corporation, and the plant it is proposed to instal is similar to that of the South Metropolitan Gas Co. It is understood that Major O. N. Braithwaite, M.P. for the Buckrose Division, is prominently identified with the scheme, and it is stated that the industry will find work for a considerable number of men.

Scotland

The year has not opened badly in Scotland as far as business is concerned, dyers, printers and finishers having received quite substantial orders during January. Another pleasing feature is the apparent settlement of the dyeing dispute. After the meeting of the Amalgamated Society of Dyers and Bleachers and the Scottish Federation of Dyers, a provisional settlement was reached which is to be recommended to the unions for acceptance.

The tweed trade is still a little less busy than before, the general high level of prosperity of the last two years not having been fully maintained during recent months. In January a certain amount of machinery was still idle, although the proportion was not large, and some of the firms are still working at full capacity, but speaking generally the outlook as regards orders for the immediate future is a little uncertain.

Although the woollen textile trade of Scotland has not suffered to the same extent as Yorkshire, the present attempt to obtain safeguarding is not without interest to Scotland. The first meeting of the Board of Trade Committee was held on February 4, and some interesting figures were given by the applicants. The present number of unemployed was placed at 33,000. Mr. Cyril Atkinson, K.C., put forward the calculation that the importation of ten million yards of material meant unemployment for five thousand people, and that the recent imports of thirty million yards had therefore meant fifteen thousand operatives unemployed.

The formation of the Lancashire Cotton Corporation affords further evidence of the determined attempts which are being made at the present moment to overcome the depression in the textile industry. The Corporation is beginning with considerable prestige, and it is hoped it will succeed in its aims. So long as Lancashire and Yorkshire are suffering from the present depression, the dyeing and finishing trades, and also the dye manufacturers, must have correspondingly less business.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

Fast Dyeing and Dyes

WE have already drawn attention to the importance of Mr. James Morton's paper before the Royal Society of Arts on "The history of the development of fast dyeing and dyes," the final instalment of which is published in this issue. Apart from the interest attaching to Mr. Morton's successful efforts in the production of vat dyestuffs, there are some points in the paper of supreme interest from the point of view of research. For some of the most important chemical discoveries were made in a "slump" period, when the chemists, although not required for production, were wisely retained to pursue research, and to pursue it with most fruitful results. In the course of a visit to the United States, Mr. Morton came across a new process for the production of phthalic anhydride from naphthalene by an air oxidation process. Not only was it found possible to produce anthraquinone from naphthalene instead of from the more limited and more costly anthracene, but a new way was found to important derivatives of anthraquinone without passing through the anthraquinone stage. It was a striking example of how faith in research justifies itself.

A Tribute to Chemists

In the course of the paper some striking tributes were paid not only to the brilliance, but to the loyalty of the chemical and engineering staffs. "They began," Mr. Morton said, "a very small band indeed, but they were loyal to the venture, and those who were there at the first, some fourteen years ago, are there to-day. We have not had cause to dispense with the services of a single chemist through all those years, nor has one left us, though several tempting offers have come their way, and we have never engaged a chemist with previous experience in dye-making. It has been a band of ever-increasing strength, working in the friendliest co-operation and loyalty under Dr. Thomas, their head. We have had to mourn the loss, through death, of two young chemists, one of them, A. H. Davies, a scientist of great ability and promise. And we have been lucky during most of these years in the official co-operation of Sir William Pope, of Cambridge, whom we look upon as the father of our team, while for an even longer period we have had the countenance and constant interest and encouragement of Professor Armstrong, our chairman to-night, whom we may call the grandfather of the family. His visits, of a purely friendly interest, in the early days were a source of great help and inspiration, which I should wish to put on record."

A Final Message

The experiences described in this notable paper enabled the author and his colleagues to appreciate the more the gigantic work represented by the growth of synthetic dye-making in Germany in the past fifty years. "Only ignorance," Mr. Morton stated, "would try to belittle what has been accomplished by the chemists of that country during these past decades. If you young chemists want to be enthused and get inspiration for your work,

read the story of the inception and development of synthetic indigo as told by Dr. Brunck in his historical speech at the opening of Hoffman House, in Berlin, in 1900. . . . But we must never forget, and the Germans always graciously acknowledge it, that they got the scent of all this trail from the young man Perkin of this country, who kept it valiantly for many years. We lost that trail some fifty years ago, but in the upheavals of these recent times our senses have again been quickened, and we have, I hope, caught up that trail again. This is all I should want to claim from 'he recounting of the incidents I have given you. We are again in the field, and it is for you young ones to keep keen of scent. See that you prove good sportsmen and that the trail be never again lost."

Artificial Light Tests

Imperial Chemical Industries, Ltd., have applied for a patent for an apparatus for the examination of dyed materials in artificial light. Owing to the difficulty in making an accurate comparison between the effects of daylight and artificial light on dyed materials an apparatus has been designed by the British Dyestuffs Corporation expressly for this purpose. It consists (Figs. 1 and 2) of a

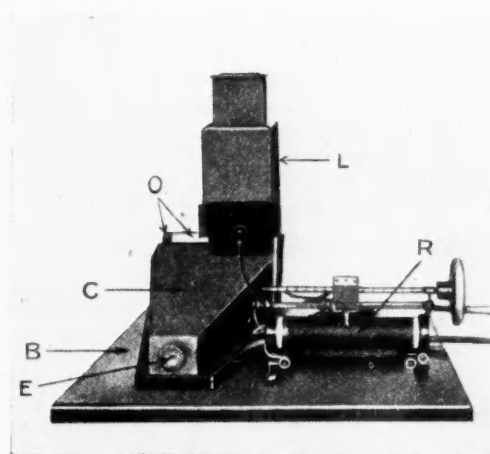


FIG. 1.—SHOWING EYEPIECE END.

casing C divided into two compartments by means of a longitudinal division D. At the narrow end of the casing is an eyepiece opening E, the opposite end being closed by means of the shutter S holding a wooden slide W. Above one compartment is a lamp casing L holding an electric filament lamp F the light from which is scattered by a ground-glass slide G. The lamp is ventilated with screened ventilation holes. One compartment is illuminated by daylight which enters through the side and top at O, while the other compartment is illuminated by the light of the lamp. A door K in front of the lamp casing allows the ground glass or lamp to be removed and other lamps

inserted. The casing is fixed to the base board B, where a switch or plug P, together with a variable resistance R, are connected with the lamp.

Method of Use

Duplicate patterns of the material to be examined are fixed one on each side to the slide W and the shutter S closed. The apparatus is placed adjacent to a window so that the opening O is well illuminated with daylight. The lamp is then switched on and the patterns viewed through the eyepiece E, when the two patterns of the material are seen simultaneously illuminated by daylight

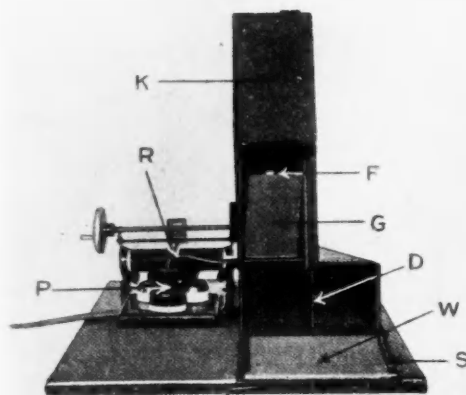


FIG. 2.—SHOWING COMPARTMENT TO TAKE DUPLICATE PATTERNS.

and artificial light respectively. The intensity of the artificial illumination is then adjusted by means of the resistance R until it is equal to that of the daylight, when the change in tone, if any, can be readily seen. Various types of filament lamps can be used to give light of varying quality. This apparatus can also be used for testing "daylight" bulbs or "daylight" filters. For this purpose dyed patterns should be selected which show marked differences when examined in daylight and artificial light.

Dyestuffs and Bacteria

"The benefits we have received in trade development, health, and beautiful objects in our lives is a debt to the dyestuff workers," Dr. Percy Bean declared in a lecture to the Manchester Athenæum Textile Society. Dr. Bean said that we had to realise the enormous amount of chemical knowledge gained through the work on dyestuffs. The manufacture of dyes and intermediates had brought about advances in our chemical industries in many directions. Unfortunately, dyestuff intermediates were akin to many explosives and poisonous gases which might be a menace to civilisation. Yet perhaps we might offset such a disadvantage by the discoveries of drugs, medicines, and antiseptics which had led to the preservation of life and the prevention of disease.

Selective Action on Bacteria

One use of dyestuffs with which the average person was not familiar was in medical work. There were hundreds of different bacteria more or less alike in appearance, but it was possible to classify them partially by their reaction to different stains and their absolute identification by other means became simpler. Without suitable

dyes medical science could not have made such great progress. Then again, certain dyestuffs were used as internal medicines. It had been found that basic colours possessed antiseptic properties in various degrees, and this discovery had proved very useful during the war. Obstinate septic wounds were found to yield to treatment with Brilliant Green and Malachite Green more readily than with most other antiseptics.

Dyestuff Licences in February

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during February has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee. The total number of applications received during the month was 611, of which 538 were from merchants or importers. To these should be added 17 cases outstanding on January 31, making a total for the month of 628. These were dealt with as follows:—Granted, 578 (of which 556 were dealt with within seven days of receipt); referred to British makers of similar products, 39 (of which 25 were dealt with within seven days of receipt); outstanding on February 28, 11. Of the total of 628 applications received, 581, or 93 per cent., were dealt with within seven days of receipt.

Fadeless Fabrics

At the Ideal Home Exhibition, now under way at Olympia, London, an interesting light on the psychology of the retail buyer was shed by the remark made by a salesman, at a stand displaying dyed fabrics, to an inquirer: "They're all fadeless, madam." It is generally held that it is in the United States that the public has been most highly educated with regard to the necessity for specifying fast dyes, but it is clear from the incident noted above that even in this country the same tendency is becoming clear. This was also apparent in the various model houses on view at the Exhibition, where it was emphasised that the fabrics, hangings, etc., used were of the "fadeless" type, and it is certain that as time goes on the buyer is likely to be more and more insistent on this point. The sight of a gaily-coloured coat suggested to the writer that possibly one bar to the use of brighter colours for men's wear is this very question of fastness, though the smoke and dust in the atmosphere of the modern industrial city also raise difficulties.

Wool Safeguarding Inquiry

At the continuation of the inquiry into the application for the safeguarding of woollen dress fabrics, in London, on Tuesday, evidence in support of the application was given by Mr. W. Marsden, a director of the Yorkshire Indigo, Scarlet, and Colour Dyers, Ltd., and Mr. T. Buttercase, a director of the Bradford Dyers' Association. Mr. Marsden said that his company had kept pace with all the latest improvements dealing with face cloths, and had a plant that was second to none, kept absolutely up to date and modern in every respect. He had seen many cloths of all degrees of finish imported into this country from abroad, and had no hesitation in saying that we could finish cloth equal in every respect to these imported goods. They regularly dyed and finished faced cloths from the Continent sent over here in the grey. Mr. Buttercase said that by centralisation and specialisation they had been able practically to revolutionise the processes and methods of dyeing and finishing, and the level and standard of the dyer's art had been raised to the highest point of efficiency, as a result of which that branch of the textile industry was ahead of that of foreign dyers and finishers. He added that quite a number of French firms sent their goods to the Association to be dyed.

Dyes and Their Application: Recent Technical Progress

By L. J. Hooley

THE first half of an account of the oldest literature of cloth printing, by Reinking, has already been mentioned in these columns. This, with the second half, which has now appeared (*Textilber.*, 1928, 9, 582) provides an interesting side-light on early developments in this important art. Reinking's list, which appears to be fairly complete, includes some two dozen works. The earliest of these represent the first publication of recipes and methods formerly jealously preserved as secret.

Early Books on Printing

One of the first and most important was Delormois' "Art de faire les toiles peintes à l'instar de l'Angleterre." This had a great influence on subsequent literature, and was quickly translated into Italian and German. A very little later, namely in 1773, there appeared in Glasgow:—

"The Calico printer's assistant, from the first operation of designing to the delivering of work for sale, with thoughts on Genius and Invention. Suggestions for an improved Mode of Printing, etc., and a concise history of Calico Printing. By Charles O'Brien."

The title is certainly comprehensive, and the realisation of how much this would cover at the present time shows as plainly as anything could how much the subject has extended between then and now. The works of Charles O'Neill and the classical treatise of Bancroft are also described. References to English methods are found in titles of other foreign works besides that of Delormois given above, and two titles also include mention of methods dealing with Manchester velvets and muslins.

The best books did not always have the largest sales even then, as the author mentions a small book published in Leipzig which, in spite of its meagre size and content, was able to command a price of three pounds and reach a second edition. The author does not deal, except briefly, with the contents of the volumes mentioned, possibly reserving these for later treatment.

Later, and especially with the introduction of the synthetic colours, the literature becomes more voluminous and loses its special interest.

Printing of Vat Colours

Turning to present times, many of the problems of the present day are centred round the fast vat colours. Leaving out of account the indigos, the vats have only come into anything approaching extensive use since the war, and guaranteed prints are almost new. In the printing of these vats, the preparation of the printing pastes and ageing present their own special difficulties, while even individual dyestuffs show their idiosyncrasies. The vat dyes, on account of their fastness, are liable to be awkward when things go wrong, and reserving and discharging are difficult because of the stability of the colours. Some recent work illustrative of the above may be mentioned.

The two main methods of developing after printing the pastes are by steaming and by passing through an alkaline reducing bath, of which the former is certainly most important. The action in the steamer is apparently exothermic, and consequently local overheating easily takes place. This is emphasised, and a method of overcoming the difficulty provided, in B.P. 282,133 (J. S. Wilson, G. W. Shearer, J. Thomas, and S. D. L.), where a special type of ager allows of rapid and efficient circulation of the steam so that all portions of the cloth receive uniform treatment. In another arrangement for a similar purpose (W. Jacoby and Deltex Co., U.S.P. 1,663,845), the excess heat is absorbed by moisture circulating through a series of small troughs and sheets of conductive material placed in proximity to the printed material in its passage through the steamer.

The alkaline reducing bath is of advantage for hand block printing, as the printed cloth can be kept for longer periods without spoiling. Recently the use of zinc and alkali has been recommended for the reduction instead of hydrosulphite for the same purpose of avoiding air oxidation, while in this case the development can be carried out by steaming (G. P. Appln. B. 118,355, I.G.F.A.-G.). Zinc hydrosulphite behaves

somewhat similarly. Recipes for hand block printing are given by Russina (*Textilb.*, 8, 54).

Discharge Printing

As has already been stated, reserve and discharge effects are difficult to obtain; however, in B.P. 274,178 (J. S. Wilson, J. Thomas and S. D. L.), by dyeing with a mixture of cold and hot dyeing colours and then printing with the discharging paste, such as leucotrope and rongalite, which destroys the cold dyeing colour, discharge effects are produced. As an example, an orange ground is obtained with Caledon Yellow G and Caledon Red FF and then printed with the discharging pattern, steamed and passed through a boiling 0.1 per cent. caustic soda bath, giving a design of yellow on orange.

The difference in the resistance of various vat dyes to rongalite and leucotrope is also utilised in B.P. 264,183 (I.G.F.A.-G.). The ground is obtained with the less resistant colour, and printed with discharging paste containing also the colour of higher resistance. Only sufficient rongalite and leucotrope is used in the discharging paste as is necessary to discharge the ground and reduce the illuminating colour; with too much the illuminating colour also may be destroyed.

Anthraquinone vat discharges on indigoid dye grounds are rather more readily obtainable, although here the fastness of the print is not so uniform. Haller (*Textilber.*, 9, 924) gives recipes for discharging anthraquinone vat colours on indigo grounds, using in the discharging paste rongalite, ferrous sulphate and tin salt. After steaming, the prints are given a hot alkaline passage. Examples with patterns are given on grounds of various Ciba colours.

Nowak discusses the manganese reserve in printing with anthraquinone vat blues (*Ibid.*, 1927, 8, 861), as does also Pomeranz (*Ibid.*, 9, 764). Another method of producing colour reserve under vat dyestuffs with vat dyestuffs is described in D. R. P. Appln. L. 64,889 (Lauterbach). Insoluble metal salts or hydroxides, carbonates, etc., are used as reserving agents. In an example, Yellow G is printed with lead acetate, potassium carbonate, gum senegal and kaolin as colour reserves; this is then dried and dyed in a hydrosulphite bath with Indanthrene Blue RS. Using a slightly different reserving paste, the reserve may be dried and steamed after printing and before dyeing.

Thickenings and Solvents

Haller gives a description of investigations into the preparation of thickeners for colour pastes (*Textilb.*, 1928, 587), and also a paper on the use of oils in the preparation of printing pastes, with photomicrographs of specimens obtained with Printogen, olive oil, ricinoleic acid, etc., along with gum arabic, tragacanth and starch thickening (*Ibid.*, 8, 1021. See also Schindler, *Ibid.*, 8, 1030).

Glycols containing from 3 to 5 carbon atoms are described as especially suitable for use in printing basic colours on account of their solvent power (B.P. 292,441, R. Gaunt, C. L. Wall and Bleacher's Association).

Another good solvent for basic dyes is formamide, preferably with resorcinol added. When the mixture is used, the basic dyes can be fixed by steaming without using a tannin mordant or other fixing agent (G.P. 435,092, I.G.F.A.-G.).

Multi-coloured and Variegated Effects

Some new devices for obtaining pattern effects without printing colour are to be reported. Holden has brought out an effective method involving printing with gelatin, which enhances the affinity of fibres, especially cotton, for dyestuffs. The goods are immersed or padded with a hot solution of gelatin, steamed for one hour, and washed. On dyeing, the parts so printed take up more colour than the others, so that a pattern effect in one colour, but in contrasting depths, results (B.P. 295,203). The process is very effective with pile fabrics. Another method, also for pile fabrics, has been patented by G. E. Holden, H. Livsey and J. and J. M. Worrall, Ltd. In this the fabric is printed with an oxidising agent and singed, the pile being burnt away where the oxidising agent is present.

The advantages of such methods are that a stock of the treated fabrics is obtained which can then be dyed in a whole

series of colours to give a range, while a new shade can be obtained on very short notice without having to print. In B.P. 268,389 (Heberlain), a pattern is obtained by passing through heated embossing rollers, then mercerising, the embossed portion being less affected.

Variegated effects can be obtained by localised dyeing of the yarn in the form of hanks, followed by weaving. This involves no printing, but each separate effect requires, generally speaking, a separate weaving. A variation of the floating film method of producing non-repeat patterns is described by R. S. Bracewell (U.S.P. 1,668,934). The process uses vat or sulphur colours. These are ground with oils

in their non-reduced state, thinned down to be free-flowing, and then floated on a non-solvent liquid such as water. The fabric is brought into contact with surface fibres and afterwards dried. The colour is fixed by reduction and oxidation. In B.P. 267,548 (Eclipse Textile Devices), the yarn is spot dyed in cross wound bobbins, the dye being delivered through perforations in a cone and distributed through the yarn centrifugally by the rotation of the bobbins.

Variegated effects in dyeing are obtained by first dyeing, then squeezing the material out of contact with the dye liquor, and again immersing in parts and squeezing. This is of main interest for paper (B.P. 295,778, Pacific N.W. Paper Mills).

The Development of Fast Dyeing and Dyes

The Story of Scottish Dyes Completed

Below we publish the concluding instalment of Mr. James Morton's recent paper before the Royal Society of Arts on "The History of the Development of Fast Dyeing and Dyes." In this Mr. Morton describes the further successes of his chemical staff in the production of fast dyes, such as Alizarine Sapphirole (Solway Blue) and Caledon Jade Green, etc., and of soluble anthraquinone vat dyestuffs, etc.

APART from these vat colours for our cotton trade, one of the dyestuffs that lay nearest to our path, and one that we knew would be of great use to the trade of the country, was what had been known as "Alizarine Sapphirole," one of the sulphonated-amino-anthraquinones, containing hydroxyl groups. This came in for early investigation, and by March, 1916, we had produced it in small quantities, while by the summer of that year we were making it for use in our own carpet dyehouse, and had sold little lots quietly to our carpet friends, who prized it mightily. It is the fastest of the acid wool colours, and was looked upon as the key colour in blues for wool. Indeed, if it had been permitted to import one dyestuff during the war, and if there had been a census among wool dyers, the vote would have gone overwhelmingly in favour of Alizarine Sapphirole. To give you some idea of the value of this colour, and the great loss felt by its absence, I think it worth while giving you a statement from important persons in the trade, which will speak for itself. On November 23, 1916, Mr. Sutcliffe Smith, a director of the Bradford Dyers' Association (and for some years now chairman of the Colour Users' Association), wrote an urgent letter to Mr., afterwards Sir, Milton Sharp, chairman of that company, urging him to do all in his power to stimulate the production of Alizarine Sapphirole by some firm in this country, and in order to show its extreme importance, he proceeds:—

"During the first six months of this year we dyed for this trade 55,872 pieces. The average value of these pieces amounts to £14 per piece, making a cash turnover value of £792,208 for the six months.

"On account of our inability to obtain Sapphirole, our output has been so seriously curtailed that had we been able to secure this dyeware, we could, with the same men working the same number of hours, have turned out 83,808 pieces as against 55,872, and the value of goods passing through our hands would have been increased to £1,173,312, or to sum up, goods to the extent of a further £762,208 would have been treated in a year. No effort should be spared to produce this dyestuff, as I cannot over-estimate its importance to the whole of the textile trade, and its production will not only rehabilitate British reputation, but will be a distinct step in advance and a serious attempt to strike at Germany's supremacy."

Importance of Alizarine Sapphirole

So much for the importance and value of this dyestuff to one firm, and that was typical of the whole woollen and carpet trade over the country. This letter was written on November 23, 1916, and was quite unknown to me at the time. We had been making the colour, using it ourselves and supplying it to a few friends in the trade, as you have been told, for six months previously.

But, as I must explain at this point, we had given no publicity of any kind to our dye-making activities. We were using our production mostly for our own trade, and so had no occasion to advertise these activities or whatever achievements we might be said to have accomplished. On November 28 of that year, 1916, there appeared a very triumphant adver-

tisement in the morning papers from a large dye company, under the heading "A New British Dyestuff—Indanthrene Blue," and claiming that whereas German chemists had prophesied that no British firm would produce this vat dyestuff within ten years, they had now accomplished that feat. In spite of my native modesty I thought it only fair to our chemists and to the situation generally to let it be known that this feat of the big dye company did not represent the high-water mark of British achievement—that we had been making that colour and others of the same series for over eighteen months, and that many thousand yards dyed by these colours had already gone from our works to all parts of the world.

Many Inquiries

This letter of mine to the public press had the effect of bringing many inquiries from users, and among them one from the Bradford Dyers' Association, who had learned that besides vat colours we were actually producing Alizarine Sapphirole, which, as I have shown, they were so much hungering after. It led to an immediate meeting between the directors of that company and myself and much useful collaboration afterwards. They had delivery of the Sapphirole—which we called "Solway Blue"—within a few weeks of our meeting, as well as of some of the vat colours, and they have not ceased to get them in increasing quantities and varieties from that day to this.

I want here, if I may, to put on record the great stimulus given to our effort by the directors of that company, especially by their late chairman, Sir Milton Sharp, who, both in private and public, was so frankly generous in his appreciation of our efforts. It was a great help and stimulus at a difficult time. And these things are not forgotten.

As I have said, that little bit of almost compulsory publicity brought us inquiries for colours from users all over the country, and we had to multiply the production as quickly as the conditions would allow. Of that most indispensable blue colour we were making by 1918 half the total pre-war imports, and by 1919 50 per cent. more than the total imports, while to-day our production is several times the total pre-war imports, and the colour is also made now by other firms in this country.

This was, perhaps, one of the chief services we rendered to the general trade of the country at that time, and I think users were agreeably astonished at the moderation of our price—I sometimes think now that had they been dealing with a Scotchman from Aberdeen instead of one only from Ayrshire, they might have been asked to pay a somewhat different figure for a commodity so invaluable at the time—one of those little facts of which one likes to remind the users in our controversies to-day!

With these outside orders rushing in—we had one contract for 100 tons of colour—our dye-making section was becoming a place of considerable activity, and it was at this time that we decided to detach it from our textile business. It was then run under the name of "Solway Dyes Co.," still owned and operated entirely by ourselves. I was averse then to inviting outside capital for a kind of business that had so many risks, and even now might only be temporary.

But, as you can realise, all that long research by chemists,

and the erection of buildings and plant to cope with large production, had made us dip fairly deeply into our coffers, and we were only a comparatively small private concern. It was at this time it occurred to me, why should we not try to interest some American makers in the results of our hard-earned experience. The money would be very useful. Several firms over there had been making dyes, but none so far had attempted such a colour as Alizarine Sapphirole, and very little had been done on vat dyes. These anthraquinone colours were bound to have a large demand in the American market, so we set out to interest some one in the making of them with a view to helping our finance in this obvious and natural way. It was still war-time, and negotiations were difficult, but during 1918 a plant was erected in America for the manufacture of a ton a week of our Solway Blue (Alizarine Sapphirole), from plans and processes prepared by us, and two of our chemists from little Carlisle went out to set that plant a-going in America. And it is working regularly till this day.

British Methods in the United States

In the next year, 1919, I went to America with a view to further extending this idea, and it led to an arrangement between ourselves and a large chemical company in America that has been of extreme importance and mutual value. In works over there were put up duplicates of what we were doing here. That arrangement has continued unbroken, and to-day they are supplying dyers and manufacturers of America with a large proportion of their very extensive requirements of vat colours. There is a complete mutual interchange of information and experience.

But my visit to America at that time, which lasted some three months, had another result which turned out to be of far-reaching importance to our enterprise. By this time, the end of 1919, it was evident that our dyes venture was to be no passing phase and we had already taken an important step towards its establishment on a permanent basis. This step, I should like to record, was taken shortly after, and as a direct result of, a speech by the then President of the Board of Trade, Sir Albert Stanley, now Lord Ashfield. In this speech he had explained the Government policy, whereby there would be a certain regulation in the importation of dyestuffs for ten years after the war, and that certain grants-in-aid would be given towards research, and also towards construction of plant for colours not yet made in sufficient quantities in this country.

Up to this time all our dyes activities had been operated in buildings adapted or erected within our textile area, and these were proving quite inadequate to cope with the demands now being made upon us. So we decided that the future developments should be on fresh fields—near the sea for effluent, and where we could have ample supply of suitable water and good transport facilities. Ultimately Grangemouth was chosen as fulfilling these conditions. There we got a site with an option on eighty acres, and we then became Scottish Dyes, Ltd. At this juncture we invited the co-operation financially of only one outside party, a gentleman already interested in chemicals and thoroughly conversant with all the risks that might attach to a new dye industry in this country. At a later stage a few of the larger colour users and suppliers of chemicals also became financially interested in our undertaking.

The construction of this new place was going ahead while I was in America at the end of 1919 and beginning of 1920. We were laying the plans for the manufacture of anthraquinone dyestuffs on a big scale.

A New American Process

But one factor had often worried us, and now became more acute in view of these extensions, namely, the supply of anthracene, which was the basis of all our operations. This hydrocarbon forms a very small fraction of the coal tar, and very few distillers would trouble to extract it, with the result that any industry dependent on anthracene was at the mercy of a few people, and even in our short experience we had difficulties about supplies, while on several occasions we had to pay exorbitant prices. It was obvious that if another source could be found for our necessary raw material we should be on a much sounder footing for large operations.

It came to our knowledge at this time that a new process had recently been discovered in America for the production of phthalic anhydride from naphthalene by an air oxidation

process. We had been aware that the production of anthraquinone from phthalic anhydride was an alternative source of supply for our starting material, but the cost of phthalic anhydride by any previous process had seemed to shut the door to this avenue. It struck us, however, that by this new air process the cost must be so low that it might bring the process within the field of possibility. So it was one of my other missions on this visit to America to investigate this process, and to see whether the conditions were such that it might solve for us this outstanding trouble of anthracene supply. For it was obvious that if we could switch over from anthracene as our basic material to naphthalene we should be on absolutely safe ground, for not only is naphthalene much lower in price, but the supply is practically unlimited, representing as it does a fraction in the coal tar some 15 to 20 times the volume of anthracene, and it is isolated by practically every tar distiller. It was worth any effort to enable us to realise a condition of this kind. But would it be possible for us to acquire the process?

I really must refrain from entering on the story of that deal in America for the British rights of this new process for the manufacture of phthalic anhydride. If I ever write a romance I think I shall call it by that sweet name. At any rate, suffice it to say that when I recrossed the Atlantic it was with this "ugly duckling" as part of my baggage. For when I presented it to our boys in the home yard and told them the cost, their congratulations, or their welcome, were, I am afraid, not too effusive!

The Sankey Judgment

But other things were happening in the dye trade just then that made the advent of expensive "ugly ducklings" not too propitious. I mentioned a short time ago that we had launched on our bigger scheme of dye-making on the basis of the Government promise to restrict the import of dyes for ten years. This declaration of prohibition was given under an Act of 1876, whereby the King had power to prohibit the importation of arms, ammunition, gunpowder, or any other goods, and the Government relied on the words "any other goods" to enable them to exclude chemicals and dyestuffs. In August, 1919, this was contested by a firm who wished to import certain chemicals, and the Court, by what was called the Sankey Judgment, held that the words "any other goods" in that connection did not refer to chemicals or dyes, and that the Government had no power to prohibit the importation of these materials. As a result, there followed a full year in which users were free to import all the dyestuffs they wanted, and at the same time the Government saw fit to take as part of their reparation payments from Germany huge quantities of dyestuffs. So that during the year 1920 and into 1921 it is claimed that dyestuffs to the value of something like £7,000,000 were arranged for import to this country. At the same time the Indian market, which had formerly been considered a closed market to German dyes, was made free to that country, with the result that large contracts which had been given to dye-makers in this country, ourselves included, were immediately repudiated. On the heels of this came what was known as the slump in trade, when demands for goods of all kinds seemed to stop in a single night. That combination of events made melancholy times indeed for the dye-makers here, who had erected or were just erecting plants to supply the total needs of the country and the Empire. It was a cold draught, indeed, two years of a bitterer wind than one ever wants to know again.

Productive Research during Slump Period

But this hiatus, like adversity, was not without its uses. If our chemists were not needed for production they could research; they could improve and revise many existing processes, and they could venture out on new fields. So in these two adverse years, though we drew in our horns in many ways, we did not dispense with the services of a single chemist. Indeed, it was a time of precious research, which bore much good fruit, as you will see.

And, among other things, it gave time for our chemists to make better acquaintance with the ways of the little "ugly duckling" which I had thrown among them so unexpectedly. Like others, it had passed through a hazardous time enough. It seemed to contract certain foreign troubles as well as some home maladies, but at length it developed some quite unexpected feathers, and was soon to become the pet bird of the flock. For our chemists discovered that these beautiful long

white crystals of phthalic anhydride were capable of flights they had never anticipated. We had certainly expected them to bring us anthraquinone from naphthalene that would make us at least independent of the more limited anthracene, and perhaps at a lower price. This was soon accomplished, but our chemists found that not only could they get an anthraquinone of the requisite purity much more easily, but that it offered a ready avenue to new and important derivatives of anthraquinone without the necessity of passing through the anthraquinone stage—the white wings of the anhydride made possible the flight free of that island altogether.

As you chemists may know, a simple transformation involving phthalic anhydride consists of the production of benzoylbenzoic acid from it by condensation with benzene. Benzoylbenzoic acid is simply anthraquinone with an extra molecule of water added to it, thereby leaving one of the links open between the two outside rings of the molecule. When this ring is closed by extracting the water with an agent such as sulphuric acid, anthraquinone is formed. But in most of our operations for which anthraquinone is needed it is not necessary to isolate the anthraquinone, so that the benzoylbenzoic acid acts as a raw material, and can be directly converted into any intermediate for which anthraquinone was formerly used. The application of this discovery by our chemists as a new use of phthalic anhydride is of far-reaching importance in the realm of anthraquinone dye-making, and is the subject of several Scottish Dyes patents. It now permeates into practically all branches of our many processes, and has enabled these anthraquinone derivatives to be made with a degree of purity and at a price that was unattainable from the old process from anthracene. Indeed, it may be looked upon in the nature of a revolution in that section of dye-making.

One outstanding result of this process, and one that could never have been attained otherwise, is that it has enabled Scottish Dyes to make and put on the market a vat blue colouring matter, which is without question the fastest blue on the market, and what is more, it is the fastest blue that has been made anywhere at any time, ancient or modern—a very big claim to make! It has only been on the market some three years, and it will give you some idea of its recognition by the users of dyes when I tell you that of this one blue we now make more tons a year than the total imports of all vat colours put together before the war. That I look upon as one of the greatest achievements of Dr. Thomas and his staff of research chemists, done largely during the slackness created by the "dump" and "slump" period—but, as I modestly remind them, something they could never have done but for the advent of my not too welcome "ugly duckling" the phthalic anhydride.

But our "duckling" is only at the beginning of its hatching. The latest product from it is Alizarine Red (Turkey Red) by a new process from parachlor-benzoylbenzoic acid, a derivative of phthalic anhydride. This red is the purest of its type that has yet been made, and a plant for its production of about 20 tons a week is now in operation. Another product about to be produced is benzoic acid of a very high purity, and phthalic anhydride is also now beginning to be used in this country for the manufacture of condensation resins for electrical work, and its uses in other directions keep ever on the increase. We are now making many tons a week of this beautiful crystal phthalic anhydride for our own use and general sale, and the plant is about to be doubled.

Caledon Jade Green

But I must now refer to another product whose growth was specially nurtured during that adverse year till it ripened and fell into our harvest basket to brighten an otherwise gloomy autumn. I refer to Caledon Jade Green, a product by which Scottish Dyes has perhaps become better known than by anything else we have done. But that was not the result of a day or a year. As users before the war, we always felt much the want of a green of pure quality for our *Sundour* goods, and early in the days of our dye-making, and as soon as we had research chemists of our own, I determined we should have a hunt for such a green. It was one of the obvious blanks of the vat palette, for we had pure blue, yellow, purple and red, and I somehow felt that somewhere amid that maze of compounds a green such as was wanted was lying buried. It was a vast field that had to be explored, and we knew it

must be a long and tedious road. For over four years one or more of our chief chemists and assistants were engaged mainly on this quest. Long periods there were of blank sterility, but ever and again little crops of verdure would give indications of something coming, only to be left behind again, and the hunt restarted. Till at last on the 11th September, 1920, the chemists came triumphantly to me with the first few grammes of the beautiful green colour that has not changed since, and that has indeed made history for itself and Scottish Dyes. It was somewhat bluer in tone than one had hoped for, but a beautiful jade, and it was there and then christened, and has ever since been known as, "Caledon Jade Green."

The provisional specification was filed on November 27, 1920; the complete patent was granted on May 29, 1922, the British number being 181,304, and the Jade Green patents over the world number 22 in all. Briefly, it is produced by oxidising dibenzanthrone to the hydroxy-derivative by means of manganese dioxide and sulphuric acid, and this is then methylated with dimethyl sulphate to give the Caledon Jade Green. Plant for its manufacture was immediately erected both here and in America, and in a short time it had made a place for itself second to none in the vat range. But why was it so important a colour that it should make such an immediate impression in the dye trade? Because not only was it the only pure green of the anthraquinone vats, but it was found to be the fastest all-round colour of the whole vat series.

A Visit from German Dyemakers

We learned shortly after it was on the market that the German dye-makers had adopted it in their laboratories as their new standard for all-round fastness—a tremendous honour to a new and foreign-made colour. Perhaps no achievement up to that time had so convinced the Germans that British dye-makers were now a factor to be reckoned with.

But this colour was patented in Germany and they could not produce it. What would happen we sometimes wondered, for we knew they could not ignore the advent of a colour so outstanding as that Jade Green. In due time diplomatic soundings came, and in further due time these developed into something which may almost be called historic. For these negotiations led to a visit to us in the north of three of the chiefs of the Badisch Co. of Ludwigshafen, to discuss terms for the production by them in Germany of our Caledon Jade Green.

That was on July 3, 1925. I am frank in saying that we took the visit as a great compliment, for it was the first time I know of in at least half a century that representatives of a German company had come to Britain on such an errand. They were not easy negotiators, but we had a most friendly meeting, and at last the conditions were adjusted to the satisfaction of all parties. And now comes in the sequel to the incident which I gave you in the first chapter of my story. For you must remember that these three gentlemen were from the same company that I had visited in the autumn of 1913. So when everything had been properly adjusted and documents signed, and we were indulging in more easy talk, I recalled to my friends in a chaffing way the incident I have already mentioned to you, and Dr. Bohn's jocular suggestion of placing my bust in the vacant niche in their Hall of Honour. "What about that bust now?" I chaffed them. "Surely the Jade Green justifies the honour." Their spokesman looked at me somewhat seriously. "Bust!" said he, "Do you know, Mr. Morton, when we read your specification for that Jade Green we were so wild we had failed to discover it ourselves that we could have 'kilt' you." But they were most complimentary all the same, and in order to be quite fair on our side, I want to relate here that the collaboration with that company over this colour led to a suggestion on their part for an improvement in one of the stages of manufacture that has enabled us to produce it at considerably less cost, and has given the colour a much wider field of usefulness. In this both parties have benefited. As to the importance of the colour, I think it will not be questioned if I make the statement that it is the most outstanding discovery in the dye trade since the introduction of the first vat dyestuffs a quarter of a century ago. For this Jade Green is the fastest green made anywhere to-day. It is, perhaps, the fastest colour made anywhere. It has been on the market only a few years, and though I have not quite full data to verify it, I am going to

venture the statement that of this Jade Green there is a bigger tonnage being made in the present year between here, America, and Germany than the total tonnage of all the vat colours put together in the year before the war. And the research and discovery of that epoch-making colour was all done in the little laboratories in Carlisle.

First Soluble Anthraquinone Vat Colour

But I feel that you must have had more than enough of the details of a dye works. Before closing the catalogue, however, I want to refer to just one other phase, because I know it is one that is sure to loom largely in the future. For the most part my remarks have made reference to vat colours, and in one's mind one always considers them in their relation or application to cotton or vegetable fibres only. This is owing to the fact that except in a few cases the amount of caustic soda necessary for the dyeing of these vats makes them inapplicable to wool or natural silk, as the caustic destroys or tenders the fibres to a very great extent. It has always been a dream of the manufacturer to get the use of these fast colours for wool and natural silk, and the trade has been waiting in expectancy for its realisation ever since the introduction of the vat colours. In our textile laboratories we have spent much labour and research over this problem for several years. It was obvious that if these vat dyestuffs could be got soluble in water, and could thereby be applied direct to the fibre without vatting in an alkaline bath, the desired end would be attained. This is a research I caused to be instituted in our textile dye laboratories some years ago, and in August, 1924, we were at last successful in finding a suitable process for rendering these anthraquinone vat dyestuffs soluble in water. This process was at once handed over to Scottish Dyes to develop on a manufacturing basis, and in January, 1925, we issued from our works at Grangemouth, Caledon Jade Green in a soluble form as the first of what we called the "Soledon Dyestuffs."

This was the first anthraquinone vat dyestuff to be put on the market by any firm in a soluble form. A few months previously a Swiss firm had put indigo on the market in a soluble form under the name of Indigosol, but it was by a different process of manufacture, and they have confined their commercial activities so far, with perhaps one exception, to the production of soluble indigoids or closely related compounds.

This is a development that is now going on at Scottish Dyes in a vigorous way, and has very great potentialities. It is a problem, so far as anthraquinone vats are concerned, that has been waiting to be solved for many years, and I am sure in time to come it will be one of the main claims to distinction attaching to the chemists of this country at this time that the long-looked-for solution has come from the chemists of these two British concerns—Morton Sundour Fabrics and Scottish Dyes. It is difficult to prophesy, but I do not think I should be far from the mark if I hazard the statement that in ten years' time all the so-called fast vat colours will be used mainly in this soluble form on cotton and other vegetable fibres as well as wool and natural silk, and I shall be much surprised also if they are not all, or mainly all, made by the new and simple process developed and fully patented in all countries by our two companies.

Tribute to Chemists and Engineers

I want to record here the splendid support given to all this work from its very inception by the chemists and engineers of the concern. They began a very small band, indeed, but they were loyal to the venture, and those who were there at the first, some fourteen years ago, are there to-day. We have not had cause to dispense with the services of a single chemist through all those years, nor has one left us, though several tempting offers have come their way. It has been a band of ever-increasing strength, working in the friendliest co-operation and loyalty under Dr. Thomas, their head. We have had to mourn the loss through death of two young chemists, one of them A. H. Davies, a scientist of great ability and promise. And we have been lucky during most of these years in the official co-operation of Sir William Pope, of Cambridge, whom we look upon as the father of our team, while for an even longer period we have had the countenance and constant interest and encouragement of Professor Armstrong, our chairman to-night, whom we may call the grandfather of the family. His visits, of a purely friendly interest,

in the early days were a source of great help and inspiration, which I should wish to put on record.

In these more recent days we have all been adopted and become part of a much larger family, for we were considered worthy of being included among the group which now forms the great Imperial Chemical Industries, and while we continue our own activities and carry on along the old lines, we bask in the beneficence of the big chemical sun, and I see no reason why under it we should not produce fruits more precious and plentiful than ever in the past. For research is made more possible, and, what is most important, the fruits of research are capable of immediate realisation by reason of that great Bank on the River Thames.

A Closing Message

In closing the first part of my story I told you how the threads of our web had suddenly been snapped, and that the second part would tell of the gathering up of those broken ends, their piecing together, and the starting of our new web. The work involved in all this process has kept us so busy and so absorbed that one has scarcely had time to look at this new web now that it is in full swing again. And had it not been for the kindly insistence of friends I question if one would ever have taken the leisure to sit down and look at it all in the way that the preparation of this paper has entailed. And when one compares the new with the old, I am sure you will agree that we have now a web whose threads have in them a strength and an interest incomparably greater than anything they ever had before; for every colour we use now speaks and lives and is full of the intensest new meaning. For instead of colour being only a blank page to us it is now filled with a story of the supremest interest, of long arduous research, of high pressures and high temperatures, things attempted and done, and telling also of things yet to do that are full of hope and adventure, which, after all, is real life.

I only hope that in what I have said I may not have given the feeling of too much self-satisfaction in our accomplishments. There has been in certain quarters some adverse criticism of the slow progress being made by dye-makers in this country, especially in relation to vat dyes; and some of the statements I have made I have thought perhaps overdue in reply to such criticism. But I can assure you that we are only too aware of the minor part we play in the great field of chemistry and even of dye-making. What we have learned and what we have done have only taught us how marvellous are the wonders of the new world to which we have been introduced, and of which we have touched only the margin. And among the things it has enabled us to appreciate the more is the gigantic work represented by the growth of synthetic dye-making in Germany in the past fifty years. Only ignorance would try to belittle what has been accomplished by the chemists of that country during these past decades. If you young chemists want to be enthused and get inspiration for your work, read the story of the inception and development of synthetic indigo as told by Dr. Brunck in his historical speech at the opening of Hoffman House, in Berlin, in 1900. It tells a story of initiative, skill, and indomitable perseverance against obstacles for a period of eighteen years that are worthy of a great epic. And no one must ever deny them the honour due to that great work and others like it. But we must never forget, and the Germans always graciously acknowledge it, that they got the scent of all this trail from the young man Perkin of this country, who kept it valiantly for many years. We lost that trail some fifty years ago, but in the upheavals of these recent times our senses have again been quickened, and we have, I hope, caught up that trail again. This is all I should want to claim from the recounting of the incidents I have given you. We are again in the field, and it is for you young ones to keep keen of scent. See that you prove good sportsmen and that the trail be never again lost.

Du Pont Rayon Developments

E. I. DU PONT DE NEMOURS AND Co. have completed arrangements to acquire the entire ownership of the properties and business of the du Pont Rayon Co. and the du Pont Cellophane Co. While the du Pont company has heretofore owned a majority of the stock of these companies, there has been a substantial outstanding minority interest owned by French textile interests. It is planned that the du Pont company shall carry on the businesses of du Pont Rayon and du Pont Cellophane through wholly owned subsidiary companies.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

DYESTUFF sales during the past month are to be regarded on the whole as satisfactory, there being a definite increase in February over January. Users commonly allow their stocks to run down as far as possible in view of the stock-taking at the end of December, and January usually sees additional buying to make good the depletion; consequently, it is felt that there was a real improvement in the second, as compared with the first month of the year.

The subject of dyestuff prices continues to be considered and discussed. There are surprisingly different views expressed by colour users in regard to the policy of price reduction initiated by I.C.I., and naturally followed by other dyemakers. The average dye user is not by any means so pleased with the reductions made as those outside the trade might easily expect. The probable reason for this is interesting.

While on the whole, the spinning and manufacturing sections of the cotton industry have been passing through extremely difficult times during the past seven years, the dyers and finishers have been in a relatively fortunate position. This is no doubt due in part to the existence of effective selling organisations in these trades, but it is certainly the case that when a dyer has been asked to reduce his prices to help the other sections of the cotton industry, he has often ascribed his inability to make any reduction to the high prices charged for dyestuffs under the protection of the dyestuff import restrictions. Now that a substantial reduction in the prices of a very large number of dyes has been made, he is being pressed hard by merchants and manufacturers to give a substantial reduction. Whilst there are exceptional cases in which this is possible, it cannot be said that the reductions in dye prices affect his total costs very appreciably.

Mr. James Morton (who, several years ago, published a number of calculations on the relation of the cost of dye in various classes of fabrics to the total cost of the fabric) demonstrated that in many cases the cost of the dyestuff actually present was nearly negligible in relation to the total cost. If the dyer were to give the whole of the advantage afforded him by these reductions in prices to the merchants and manufacturers, they would be intensely dissatisfied with its dimensions. Thus, the dyer is in the position in many cases of being forced as a result of the lower dyestuff cost to accept a price which shows less margin of profit than he was getting before the initiation of the new dyestuff price policy.

That this is really felt by some of the larger colour users is shown by the fact that they have in some instances actually cut down their purchases to the lowest limit possible. At the same time, the opinion has been expressed by some of their colleagues that this policy will help the cotton trade as a whole in its fight against foreign competition in overseas markets, and consequently that the policy, if it is based on a sound economic position, ought to be appreciated, and that I.C.I. is to be congratulated on having taken the initiative in such a bold way.

Yorkshire

At the British Industries Fair, the Yorkshire dyestuffs manufacturers predominated amongst the exhibiting representatives of that industry. They were L. B. Holliday and Co., Ltd., Brotherton and Co., Ltd., Hickson and Partners, Ltd., and last, because only in part a Yorkshire concern, Imperial Chemical Industries, Ltd. Although Brotherton and Co., Ltd., manufacture their colours at Birkenhead, Leeds is the company's home and headquarters.

Shrinkage in this section was observed and reported last year. This year there is a further notable absentee among the Yorkshire makers, a firm who have supported the Fair from its inception. There is, however, no decrease in the number of firms manufacturing dyestuffs in Yorkshire, despite price cutting tactics which had been going on with regard to some of the dyestuffs such as sulphur blacks, for some considerable length of time before they were discussed in the Press.

The county cannot be said to have derived much in the way of immediate and concrete orders, but it is not disappointed, or its previous experience has taught it not to expect them.

Rather has it been the object of the exhibitors to show the buyer from overseas that Britain still has a dyestuff and intermediate industry, trusting that such showing will, in due season, bring inquiries and orders.

Trade has ceased to move on the upward grade, but is regarded as suffering from only a temporary check. Turnovers have not been so good as in February last year, due, no doubt, to reduced prices. "More blue serges" is a forecast of demand for the summer of this year, which, if realised, should make its effect felt in the Huddersfield mills. The trend appears to be in favour of the piece dyer as against the dyer of loose material and yarns, who has had a good innings under the direction of Dame Fashion during recent years. Lighter cloths, blue, blue greys and brown, practically without design, but of very smooth finish and texture, are also selling well.

The richly-coloured cloths so fashionable not so very long ago are losing popularity. There is a steady production of the better grade cloths in both woollens and worsteds, merchants putting forward some effort to ensure that the tailoring end of the industry shall have ample stocks to deal with the rush of orders expected within the next few weeks.

If the decrease in the numbers of the "live" registers at the local employment exchanges may be accepted as evidence, there has been a substantial improvement in the heavy woollen trade during the latter half of February. The most recent returns show a decline of 320 at Dewsbury, 207 at Batley and at Birstall, 320 at Ossett, and 82 at Mirfield. Profits of the Yorkshire Indigo Scarlet and Colour Dyers, Ltd., the well-known Leeds concern, for the year to December 31 last amounted to £12,413, which, with the profit on sale of investments (£1,902) and the amount brought in from the preceding year (£2,806), gives a disposable balance of £12,548 after deducting debenture interest of £4,573. The directors recommend a dividend of 7½ per cent. less tax, on both preference and ordinary shares, after which it is proposed to place £1,000 to reserve fund and carry forward the balance of £4,560.

Scotland

FEBRUARY has seen the continuation of the good opening made at the beginning of the year, and although the outlook for the immediate future is a little uncertain, business is holding up fairly well at present. In the tweed trade, orders for the spring and winter seasons are still coming in, but the volume is not up to that of the last two years. Exports to Central Europe and to America remain fairly satisfactory, and on the average mills are working up to about three-quarters of full capacity.

The dyeing, bleaching, and furnishing trades in the Glasgow and Paisley districts are moderately well employed, but calico printers are not too busy. Reports of still another artificial silk factory for Scotland have been heard—this time for Aberdeen.

The position in the wages dispute remains as reported last month, and a satisfactory conclusion is anticipated.

The demand for dyestuffs during the month has been moderate, with prices still on the downward trend.

The lecture given by Mr. James Morton recently before the Royal Society of Arts has aroused widespread interest. For the first time the full story of the developments represented by the Sundour fabrics and by Scottish Dyes has been told. Remembering the services made to the textile industry of Scotland and the Irvine Valley in particular by the late Mr. Alexander Morton, his father, Scotland may well be proud of the achievements of these two pioneers.

The Value of Fire Extinguishers

THE Fire-Foe Company announce that their fire extinguishers have proved very successful in dealing with outbreaks of fire at Kenrick and Jefferson, the well-known printers and business equipment firm of West Bromwich, and All-weather Weather-shields of Birmingham. The prompt extinction of fires has in many instances been the means of preventing very serious outbreaks and possible total destruction of premises, and business houses will do well to bear in mind the achievements and proved tests of various types of extinguishers.

Dyestuffs Monthly Supplement

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Communications relating to editorial matter for the *Dyestuffs Monthly Supplement* should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

B.D.C. Dyestuffs Policy

IN the annual report of Imperial Chemical Industries, just issued for the past year, it is stated that in the matter of dyestuffs satisfactory progress is being made both technically and commercially, and several important additions have been made to the range of colours produced. The policy of the British Dyestuffs Corporation, it is stated, represents in effect a national attempt to establish a British industry which has as its objective the independence of this country in the production of dyestuffs and inorganic chemicals. With this end in view, the company has made substantial reductions in the prices of dyestuffs, representing a considerable present sacrifice, but justifiable as tending to place this side of the business on a more healthy basis, and at the same time giving assistance to dye users. The words "representing a considerable present sacrifice" will not escape the notice of those who are affected by the price-reduction policy.

Azoic Colours on Wool and Silk

The well-known firm of John W. Leitch and Co., Ltd., of Milnsbridge Chemical Works, near Huddersfield, announce that as a result of extended investigation they are placing before their customers new processes for the application of a series of fast bases for ice colours to wool and to silk, in which the use of caustic is entirely eliminated. These processes are patented, and are covered by British Patents numbered 283,347 and 283,838 for wool and 283,347 and 283,839 for silk. Those who purchase from J. W. Leitch and Co. the bases, and the Naphthols JWL required to be used in conjunction with them under these patented processes, will be granted free licences for the use of the quantities of these materials so purchased by them. These licences will apply only to the actual purchaser for his own use of the materials and are not transferable. Examples are given in a pamphlet illustrative of the general method of procedure, but the details would naturally vary according to the depth of shade required. Two good examples of dyeings are shown—Fast Red Base FW4 and Brilliant Fast Scarlet Base FS2, both in conjunction with Naphthol JWL3.

A Caledon Publication

Imperial Chemical Industries, Ltd., have issued an interesting four-page publication on *Caledon Dyes and Caledon Dyed Goods*, now widely known in connection with Scottish Dyes, Ltd., of Grangemouth. "Caledon colours," it is stated, "are made in Scotland, and they invite interest and attention because of their fastness. Fastness is a word which has been overused and become liable to suspicion. In the case of the Caledon colours there need be no misunderstanding, and their quality in this respect can easily be defined since they are the fastest colours either made or known. To explain in greater detail, fabrics dyed with Caledon colours may be exposed to sunlight or washed at the boil. The colours will resist the effects of weather and hard wear, nor are they stained by contact with substances such as mud or salt water. From the dyer's point of view they have other equally valuable resistant qualities, as they are not affected by processes such as potting, cross-dyeing, milling, mercerisation and decatising, or treatment with acids and alkalis. The remarks made with regard to light fastness do not apply in the case of very pale shades, as these cannot be exposed to direct sunlight for any considerable length of time without fading.

This disadvantage of pale shades, however, applies to all colours, and pale shades dyed with Caledon colours are still correspondingly faster than those with ordinary products. This weakness does not apply to other fastness properties, such as washing, where pale shades are as good as dark. Some pale shades are made by weaving a dark thread with a white one, and these are quite fast.

Washing

"With regard to washing, this may be repeated over and over again without the material being affected; a good brand of neutral soap should preferably be used in the washing, to maintain the brightness of the colour and also for the sake of the fabric itself, and, of course, in dealing with delicate fabrics, such as natural and artificial silk, these must be treated with the usual precautions. When properly dyed and used, Caledon colours may be relied upon to last as long as the material. The advantages of this will be obvious, as it means economy and convenience and the elimination of the irritating precautions which have to be taken where there is fear of colours fading. With regard to uses, Caledon colours have been most widely adopted for interior purposes, such as curtains, wall-coverings, and upholstery, in which direction there is practically no limit to their resistance. They can equally well be used outside and in the tropics. Their resistance to both sun and weather is of special advantage for both clothing and equipment for seaside, summer, and sport purposes.

New Applications

"Speaking generally, their use is to be recommended in all cases where drastic conditions are to be met with, whether the colours have been previously used for such purposes or not. In this respect there is a great opportunity for pioneer work in applying the colours to new purposes, as it is only within the last few years that their possibilities are becoming anything like fully realised, and as confidence in the possibility of obtaining real fast shades increases so also will the use of these colours. The prestige of the Caledon colours is seen in the fact of their use in the principal series of guaranteed fabrics of the present day. With Caledon dyed goods the user has the advantage of obtaining materials which will keep their colour and beauty, and the dyer has the satisfaction of being able to assure his customers of using the best dyestuffs available."

Identification of Artificial Silk

Dealing with the identification of artificial silks, a writer in the current issue of the *Artificial Silk World* says that a considerable amount of difficulty is met with in the identification of artificial silks, and more especially regenerated cellulose silks, since the reactions of these fibres, their diameters and ordinary microscopic features present such slight differences as to make complete identification impossible. In the case of those fibres which have now come into the market in competition with artificial silk in the "combed fibre" industry, there is also a considerable amount of difficulty in determining their origin.

A method of examination has been recently suggested which may be used as an aid to the identification of such fibres, and one which also gives some information as to their internal structure and physical state. If a ray of light is passed through a transparent medium, such as an artificial silk fibre, a certain amount of the light will be absorbed in its passage and will be unable to pass through

the material. In an ordinary composite ray of light this loss will not be noticeable, but if we so arrange the ray of light that it consists of rays vibrating in one plane only (or plane polarise it) the inability to pass through the fibre or portions of the fibre will be quite easily noticed, and, since the passage of the ray is largely dependent on the stresses present in the fibre, a considerable amount of useful information may be gained in this way.

Application of Polarised Light

A modern development of the artificial silk industry is in the direction of combed fibres, short lengths of artificial fibres being carded and combed alone or along with wool, to produce new types of yarns, and this use of artificial silk has given impetus to the use of certain naturally occurring vegetable fibres, such as ramie, nettle, sometimes jute, and some of the aloe fibres. These can be readily detected by polarised light, since they give fairly distinct and characteristic colours, although these may be modified by preparatory treatments. A sample of degummed and caustic-soda-mercerised ramie gave, when mounted in glycerine, a deep reddish-violet fibre with long orange streaks down the side. At certain sharply defined points, apparently corresponding with the cross lines of the fibre, the colour changed to bright yellow-green, and on turning the Nicol a bright bluish-green appeared. Mounted in water, the fibres gave dark violet-red and orange as before, but down the centre there appeared a bright blue line, which started at each "node" and faded away half-way towards the next. A sample of New Zealand flax (*Phormium tenax*) showed bright green, red, and yellow spiral lines, which all turned to bright violet when the Nicol was rotated. Wool in these samples was a pale yellow-green with brown patches at the base of the scales. Boiled-off silk showed very little colour effect, only spiral lines of pale greenish-yellow being noticeable. Cotton showed a clear bluish-grey fibre, with small areas of blue and red at the change of direction of the convolutions, and the same sample mercerised showed no colour effects whatever.

A Huddersfield Personality

In the *I.C.I. Magazine* for April, under the head of "Huddersfield Personalities," appears the following cartoon-portrait of Dr. F. J. Morley, head of the triphenylmethane department of the British Dyestuffs Corporation works.



The Dye Tariff's Fate

The protracted hearings on the revision of the American tariff have been of considerable interest to American dye manufacturers, and the new tariff bill, which is about due to be reported to Congress, will be anxiously awaited. The principle of the tariff, which is frankly accepted, is that of protection for the domestic industry at precisely those points where protection is most needed. The case for protection of the domestic dye and coal-tar products' industry was laid before the committee by Dr. E. H. Killheffer, who represented the Synthetic Organic Chemical Manufacturers' Association, the Manufacturing Chemists' Association, and Newport Chemical Works. On the previous day a number of manufacturers of fine and heavy chemicals had testified on various specific products and general sections of the tariff law. In practically every case the main arguments were, first, in support of the present system of assessing duty for competitive products on the basis of the American selling price rather than United States or foreign value; and, second, in support of somewhat higher rates, needed, it was declared by several witnesses, to protect the domestic chemical industry against the attacks of strong foreign cartels. Dr. Killheffer pointed out that domestic dye prices had declined every year since the passage of the 1922 tariff, despite the contentions made six years ago that protection would result in combinations and higher prices to consumers.

American v. U.S. Basis

The distinction between American selling price and United States value as bases for assessing the ad valorem duties on competitive products may not be generally known. American selling price means the selling price of the comparative American-made product in the American markets. To assess on United States value, on the other hand, means to deduct from the selling price in the United States of the foreign-made goods, so much for profit and expenses, so much for freight and insurance, so much for specific and ad valorem duty; then on what is left the real duty is calculated. This issue has become of the greatest moment to the American dye industry, for the reason that in the present tariff the paragraphs covering coal tar products are the only paragraphs on which the American selling price is operative.

There would be little need for argument, little need to dispute the issue, were there no opposition among those who now control the United States tariff destinies. Five years ago, on March 17, 1924, the Hon. J. A. Frear introduced in the House of Representatives a bill asking for the repeal of both American selling price and United States value as bases of the ad valorem rates on coal tar products, and urging foreign valuation as the basis. This bill violently attacked the administrative clauses of the dye tariff and characterised the American selling price clause as "viciously unfair," "monopolistic" and "unworkable," and asserted that it has resulted in a condition "worse than an embargo." "Any intelligent person (says the *American Dyestuff Reporter*) who has carefully studied the records of our dyestuff imports over the past five years will understand at once how basely false such assertions are. Those who have taken pains to become informed on the issue know very well that at present our dye imports comprise far too great a range of vat colours, and constitute far too high a percentage of domestic consumption by value and by variety to justify any frantic accusations of 'monopoly' and embargo." It is added that the Hon. J. A. Frear sat on the Ways and Means Committee during the framing of the new tariff, and his presence in that capacity is regarded as "a grave misfortune to the interests of the dyestuff industry and to all consumers of dyes" since he is remembered as "the arch-enemy of the American selling price principle."

The Colouring of Rubber

Scientific Basis, Methods Employed, and Colours Used

We publish below the substance of a paper read by Dr. W. J. S. Naunton before the Society of Dyers and Colourists, and recently published in the Society's Journal.

THE manufacture of rubber may be regarded as consisting of two phases—firstly, the plantation work of rearing the trees, tapping from them the latex, coagulating, and working the coagulum into marketable form for shipping to the rubber factory; and secondly, the factory work of converting the raw rubber into vulcanised rubber goods.

The rubber mix is subjected to fairly drastic treatment in the process of vulcanisation; it is for this reason that the colouring of rubber is far from an easy matter. In cold curing, the pigment which has been milled into the rubber mix is subjected to the action of sulphur chloride; in heat curing, it is subjected to the action of sulphur at comparatively high temperatures with the additional action of live steam in the case of the open steam cure. It is not surprising, therefore, that until comparatively recently rubber was mostly black, grey, white, or red. It was the organic super-accelerators that made possible the production of the brightly-coloured rubber seen in the last few years. These have so speeded-up the cure and lowered the necessary temperature of vulcanisation that the bright shades of delicate organic and inorganic pigments can be retained unimpaired after vulcanisation.

The colouring of rubber may be considered under the headings of: (1) Uncured Rubber—(a) latex, and (b) sheet; (2) Cured Rubber—(a) cold-cured rubber, (b) soft heat-cured rubber, and (c) hard rubber or ebonite.

Latex

Hancock, in 1824, considered the direct use of latex, but abandoned it because of the difficulties in obtaining stable latex in this country. Interest is again developing around latex processes, and hence the colouring of latex is assuming greater importance. Broadly speaking, when the latex is to be vulcanised at or slightly above the ordinary temperature by means of super-accelerators, almost any dyestuff may be employed to colour it, provided the dyestuff carries a negative electric charge, and hence does not bring about coagulation.

Whether or not it is economical to employ water-soluble dyestuffs in the colouring of latex will depend upon the use to which the latex is to be put; generally speaking, when the serum is to be separated from the rubber by any means other than evaporation, it will be found to be uneconomical owing to the loss of colour in the water. When it is intended to compound the mix in the latex itself, then, by the use of a suitable filler, e.g., China Clay, the water-soluble colour may be fixed and the finished goods will not require to be surface washed to remove any free colour; in fact, this appears to be the only case in which the rubber technologist has any real practical interest in the absorption of water-soluble dyes by clays. The pigment colours and lakes may be employed in such water-compounded mixes, but must be in a fine state of division, since the dispersing action of milling in a plastic (in this case rubber) is absent. In practice, the absence of milling usually gives rise to the necessity of putting the pigment through one of the mechanical colloid mills.

Another interesting application of organic dyestuffs to the colouring of latex is found in the use of vatable dyestuffs. The vat is mixed with the latex, which is then agitated in air, when the dyestuff oxidises to its insoluble form upon the rubber particles.

Electro-deposition of Rubber

A recent development is the electro-deposition of rubber and this involves still further limitations, since not only must the colour be fine enough to give uniform coloration to the eye, but it must be fine enough to travel in the electric field and be deposited with the rubber at the anode; in other words it must possess a particle size comparable with that of the rubber particle in latex. In this connection what we formerly considered to be of excellent fineness must now be regarded as coarse; in fact, it is necessary to prepare the colours in colloidal solution. In some cases, by adjusting the conditions of the reaction, the pigments may be prepared in the colloidal state, or at least in a state of sub-division approaching that state, and after the removal of the inorganic impurities it

is only necessary to add a suitable protective colloid in order to maintain the pigment in that state; in other cases this is not possible, and it is necessary to resort to other methods of dispersion. The method which will immediately suggest itself is the colloid mill, but it is a remarkable fact that with many organic pigments the colloid mill will only reduce them to a certain state of division, quite fine enough for ordinary water-compounding, but not fine enough for electro-deposition, and repeated passage through the mill will not alter this state of affairs.

The main requirements of pigments for the electro-deposition process are that the pigment should have (1) a negative electric charge, and (2) a particle size comparable with that of latex and be free from coarse particles, which would settle out in the bath instead of being deposited on the anode. Colours for this purpose can be tested by any of the usual methods, e.g., by placing the emulsion under distilled water in a U-tube containing electrodes. Another way is to place a drop on a microscope slide fitted with tin foil electrodes (method of Cotton and Mouton).

Crêpe or Uncured Sheet Rubber

Crêpe can be coloured by boiling in an aqueous solution of a basic dye, but only comparatively weak shades can be obtained in this way. This power of a basic dye to tint raw rubber may be connected with the fact that rubber contains stearic acid, with the result that the basic dye may form an insoluble stearate in the rubber.

For the full colouring of crêpe, use can be made of its well-known property of absorption of solvents. This method is applicable not only to colours which are soluble in rubber solvents, but excellent results can be obtained also by using suspensions of finely divided pigments. Improved results appear to be obtained when the rubber solvent is mixed with methylated spirit.

Cold-Cured Rubber

The methods described under crêpe may be applied to cold-cured rubber, but less successfully owing to the lowered absorption power of vulcanised rubber. The usual method is to mill the pigment into the dry rubber mix, which is afterwards made into the spreading dough.

The range of pigments fast to sulphur chloride is much greater than the range suitable for heat curing. In fact, even the colours which are destroyed by sulphur chloride can often be stabilised by employing such fillers as chalk in the mix. Rubber-soluble colours are not popular for cold curing, since they bleed into the curing bath. Generally speaking, it is desirable to test a colour for cold-cure work not only for its fastness to sulphur chloride, but also for its fastness to the degradation products of cold-cured rubber. When the cold cure is effected by the Peachey process, which consists of treating the rubber with hydrogen sulphide and sulphur dioxide gases, the range of colours is still further increased.

Soft Rubber

The whole key to success in the production of brightly-coloured rubber is the use of accelerators. In fact one of the most difficult problems of the rubber colourist when an accelerator is employed is to find a range of colours which are completely fugitive in a white mix during cure, in other words, a range of marking colours for distinguishing between uncured white mixes. A few basic dyes will bleach out during the cure, but re-develop again after standing for a few hours.

Almost all of the organic colours are more or less fast to the curing conditions of rubber in the presence of a super-accelerator. They do not, however, all constitute good rubber colours.

Classification of Rubber Colours

Rubber colours can be divided into three main classes:—(1) those soluble in rubber; (2) an intermediate class slightly soluble in rubber; (3) those insoluble in rubber. The first two classes are purely organic dyestuffs, but the third class may be divided into three groups: (a) inorganic pigments; (b) organic pigments; and (c) lakes.

The most common colours belonging to the class of rubber-soluble colours are the reds and yellows. Blues and violets are also found and are exceptionally fast to light, but they are rather too expensive for everyday use.

As a class these colours have one great failing; not only do they dissolve in rubber but they crystallise from rubber. To use them successfully, therefore, it is necessary to determine their solubility at the ordinary temperature in the particular mix used, and not to exceed this concentration. In ordinary pale crêpe this figure is very low indeed, about 0.5 per cent. If this figure is exceeded the dyestuff will crystallise out and the crystals will slowly migrate to the surface of the rubber with the production of a dull brown "bloom" (in the case of Vulcafor Red III). Certain substances, to which reference will be made later, tend to delay this crystallisation, but still more remarkable, certain substances which would be expected to be quite inert in this respect tend to accelerate it; thus, if iron oxide is added to a mix containing Vulcafor Yellow I in such concentration as to be perfectly stable under normal conditions, the Yellow will soon commence to "bloom" out from both uncured and cured rubber.

The incorporation of these colours into the rubber is often attended with difficulties due to the big difference in solubilities at milling and curing temperatures. A small speck of dyestuff may remain undissolved after the milling, but during the curing will dissolve and produce a darker coloured spot, which owing to diffusion may become a large blot. Various attempts have been made to overcome this difficulty, such as prolonged grinding of the colour with some white pigment, e.g., blanc fixe, but only with partial success. There is, however, a method by which not only can easy incorporation be secured, but also a slight decrease in the risk of "blooming," viz., first to convert these colours into their stearates by melting them with about twice their weight of crude stearic acid. The fused mass on cooling may be roughly broken up and milled into the rubber into which it will pass with the greatest ease and perfect solubility. A mixture of stearic acid and common rosin has been suggested, but offers little, if any advantage, over crude stearic acid. The ideal solution to this problem would be to discover a protective colloid which would prevent the growth of the colour particles, but such protective colloids for substances which crystallise easily are difficult to find.

Rubber-soluble colours have great limitations in use, because they bleed from one piece of rubber to another, or into paper placed in contact. They are not fast to naphtha or most organic solvents. They are used for special purposes, e.g., marking the position of valve patches.

Colours Slightly Soluble in Rubber

The most characteristic members of the small slightly rubber-soluble group are Vulcafor Yellow and Vulcafor Scarlet. These colours are not sufficiently soluble to bleed from one piece of cold rubber to another, but when the rubber is hot they do show this tendency to a slight degree. Under no conditions will these colours bleed from rubber to packing paper.

For most purposes these colours are ideal, since they need not necessarily be in a fine state of division in order to secure dispersion; they contain the maximum amount of dyestuff and the minimum amount of filler.

Colours Insoluble in Rubber

The rubber-insoluble class comprise inorganic and organic pigments, and the lakes made from water-soluble organic colours. It is difficult to decide in some cases whether a given organic pigment should be classified as belonging to this or the prior group. Generally speaking, if it is possible to use an organic pigment as such, it will be found to be more easily dispersible in rubber than the corresponding lake, although for certain purposes the lake is to be preferred.

In the case of open-air cures, with or without pressure, the straight pigments are perfectly satisfactory, and the same remark applies to press-cures.

Transparent Rubber

The pale crêpe to be used for transparent rubber should be as free from suspended matter as possible, and great care should be taken to ensure that the rubber and compounding ingredients are perfectly dry, or turbidity will result during the cure.

The accelerator and activator should be selected with a view to perfect solubility in the rubber. Zinc or cadmium stearates are perhaps the safest activators, since there is less danger of undissolved particles than when the oxides are employed. For colouring transparent rubber, the ideal colour is one perfectly soluble in the rubber, and used at such concentration that there is no fear of any separation or blooming on storage. Rubber-soluble colours are, however, not absolutely essential, since certain colours giving in rubber colloidal dispersions which do not aggregate may be employed with success.

Another novel and interesting effect, which requires the same technique, is the production of rubbers with metallic lustres. These effects may be obtained by compounding aluminium powder into white transparent rubber for a silver effect or into transparent rubber coloured with Vulcafor Yellow I for a gold effect.

Jazz Effects

In many of the early attempts to produce marbled and jazz effects the coloured pigment was simply dusted upon the mix as it passed through the calender. The result was neither pleasing nor practical. The best effects can only be obtained by the partial mixing of different portions of the basic rubber compound into which the various coloured pigments have been properly incorporated.

There are three important considerations to be kept in mind in the production of these effects: (1) the colours employed must be practically insoluble in rubber, both in the cold and during the cure. In steam-cured goods, the selection of pigments is still further narrowed down, since some colours which do not bleed in press cures will do so in open steam; (2) the various portions of coloured mix should be of the same plasticity when put through the rolls, producing the jazz effect; and (3) the degree of mixing must be just sufficient to give the effect and no more, or dull patches will result from the bleeding of complementary colours.

A novel method of obtaining a far more natural marble pattern is to split the rubber as it leaves the calender upon which the jazz mixing has been effected (U.S.P. 255,017). From the æsthetic point of view a pleasing jazz will always be found to contain a predominance of white, or some bright colour, such as yellow. With regard to the most suitable accelerators for use in the curing of coloured soft rubbers, in press-cured goods a thiuram accelerator should be employed, and for use in dry heat preferably an accelerator of the type of zinc diethyldithiocarbamate. Quite satisfactory results can be obtained with most of the slower accelerators, e.g., D.O.T.G., except in the case of one or two vat colours, which appear under certain conditions to be partially reduced during the cure; in such cases quite excellent results may be obtained by the substitution of aldehyde-ammonia as the accelerator. The only class of accelerators which should be definitely ruled out in these effects is the resin type made from aromatic amines, since these discolour the rubber.

Ebonite

In the colouring of ebonite there is the obvious difficulty of covering up its natural brownish-black colour; this involves the use of large proportions of colour. If this colour is first covered by the use of a white pigment such as lithopone, it is necessary to overcome the hiding power of this, and furthermore the introduction of the inorganic pigment tends to give rise to a stone-like ebonite. In most cases the brightest results can be obtained by the correct balance of white pigment and colour, in fact in the case of the darker colours the use of a white pigment is essential, since at the necessary concentration these colours are in themselves very dark. With the paler colours, however, such as yellow or orange, quite bright products can be obtained in the absence of inorganic pigments with consequent improvement in physical properties.

In the successful production of coloured ebonite it is necessary to balance the three factors of time, temperature, and sulphur. It is unfortunate from the point of view of coloured ebonite that the action of accelerators in its production differs fundamentally from their action in soft rubber, inasmuch as the accelerator has no effect upon the physical properties of the vulcanisate and hence the sulphur cannot be reduced. Accelerators merely speed up the inevitable result and the beneficial effect consists in either reducing the temperature, or shortening the time, of the cure. If powerful accelerators are not used carefully they do more harm than

good in the production of coloured hard rubber, since under certain conditions they tend to generate sulphuretted hydrogen, which, apart from the harmful effect of the resulting micro-porosity upon the ease of polishing the product, tends to destroy the colours by reduction. Since many of the best ebonite colours, especially the vermilion substitutes, are vat dyes, this generation of a reducing gas is especially harmful. It can, however, be avoided by employing a well-regulated temperature rise in curing. In thick layers or masses of accelerated mix, this generation of gas may become sufficiently powerful and spontaneous to assume the character of an explosion, and cases are known where quite heavy presses have been completely disrupted by this effect.

A typical bright reddish-orange hard rubber, suitable for, e.g., fountain pen stocks, may be made as follows: rubber 100, Vulcafor Orange 125, magnesia 4, sulphur 40, Vulcafor Resin 4.

Generally speaking, the best ebonite colours are insoluble colours, especially vat dyestuffs, but these colours vary considerably, probably depending upon their ease of reduction

to the leuco compounds by hydrogen sulphide.* The rubber-soluble colours are on the whole unsuitable for ebonite, since not only do they change in colour during vulcanisation, but they tend to cause evolution of hydrogen sulphide. In all cases the surface must be carefully protected against the action of live steam. Unlike soft rubber, the surface of ebonite cannot be protected by mere cloth wrapping. Although this destructive action is only a surface effect which can be removed in the final polishing, it is in most cases too deep seated to allow the use of colours, e.g., Vulcafor Orange, in the production of dental plates, which are cured in open steam, since the plaster mould is not steam-tight. Certain vat colours, however, have been used successfully in the colouring of dental ebonites.

Another method of manufacture is press-moulding from ebonite dust. It is difficult to produce satisfactory coloured ebonite by moulding a mixture of ordinary ebonite moulding powder and colour, but satisfactory results can be obtained when the moulding powder is made from properly prepared coloured ebonite dust.

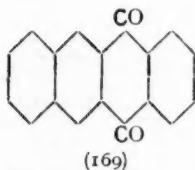
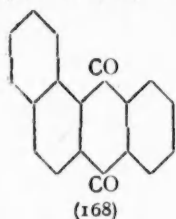
Basic Intermediates for Dyestuffs: No. XXVI.—The Complex Quinones

By "Consultant"

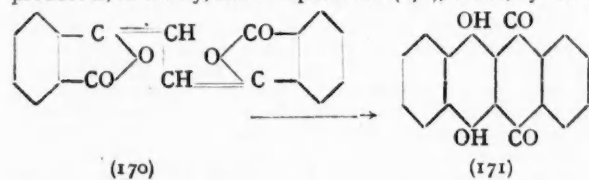
It has become almost a *cliché* to mention the colour of dyestuffs and the word "quinone" together, but the fact remains that the quinone group, both *in esse* and *in posse*, forms the basis of many of the more complex dyestuffs. The simple quinones—quinone itself and the naphthoquinones—do not find any application in the dyestuffs industry. Anthraquinone has been previously dealt with (see THE CHEMICAL AGE, Dyestuffs Supplement (1927), XVI, p. 4). There remains a large group of dyestuffs and intermediates derived from condensed nuclei containing the quinone groups, which will be described in this and the subsequent article. Exact details of the works processes are not given in every case mentioned, since only a limited number of chemical operations are involved, mainly caustic fusions and condensations in sulphuric acid; what is aimed at is a concise account of the various quinone-bearing nuclei available as dyestuffs intermediates.

The Benzantraquinones

Although the benzantraquinones are not widely used in the dyestuffs industry, their nucleus occurs many times in the dyes of the benzanthrone series. There are two benzantraquinones (168) and (169), which are best distinguished



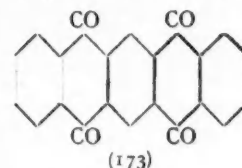
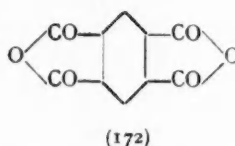
by the prefixes "ang" and "lin," indicating the angular and linear structures respectively. The linear compound (169) is seldom met with, but is of interest in that it has a relationship with the curious colouring matter obtained by the condensation of phthalic anhydride with succinic acid. The first product is, in reality, ethine diphthalide (170), which, by treat-



ment with alkali, is converted into the 5:9-dihydroxy derivative of *lin*-benzantraquinone (171). This reaction, it may be

added, is a general one, and may be used to synthesise substituted derivatives of this series. The *ang*-benzantraquinone is a well-known intermediate, which is itself used as a pigment, since its insoluble nature precludes its use as a dyestuff. It can be obtained by the condensation of phthalic anhydride with naphthalene, and is usually marketed under the name of Sirius Yellow G.

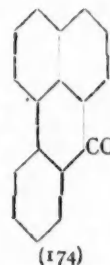
The reaction between phthalic anhydride and naphthalene is a curious one, inasmuch as it is attended by loss of water from the ether oxygen of the anhydride and two of the hydrogen atoms of the naphthalene ring. The reaction proceeds very easily in sulphuric acid solution, naphthoyl benzoic acid being formed as an intermediate compound. The reaction is a general one, and may be applied to the synthesis of a great many benzanthrone derivatives. One example of some interest is the compound formed by the condensation of pyromellitic anhydride (172) with benzene. The compound so formed (173),



lin-dibenz-1:4:5:8-anthraquinone, is capable of giving some complex Violanthrones.

The Benzanthrone

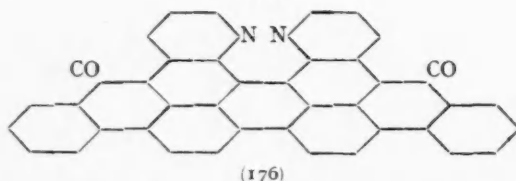
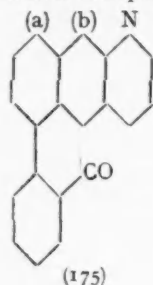
The benzanthrone nucleus (174) has only one carbonyl group, and is not, therefore, a true quinone; but its many



derivatives are so often formed by reduplication of the true benzanthrone group, with the consequent formation of a true quinone structure, that the benzanthrone themselves may be conveniently discussed under this general heading.

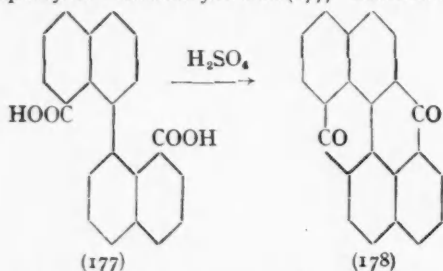
The first observation upon this class of compound dates

from the time when attempts were made to perform the Skraup reaction upon β -aminoanthraquinone. Very little anthraquinoline was obtained, but the main product was a compound $C_{20}H_{11}ON$, m.p. $251^{\circ}C$., in reality a cyanthrone compound (175) which by the Peri reaction (see under) can give deep green dyestuffs by condensation through the positions marked "a" and "b." An example of such a compound is (176).

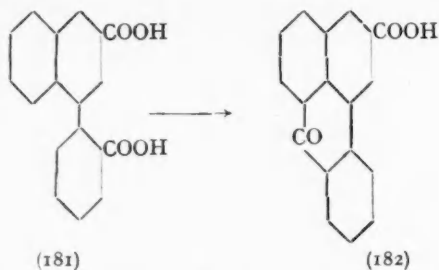
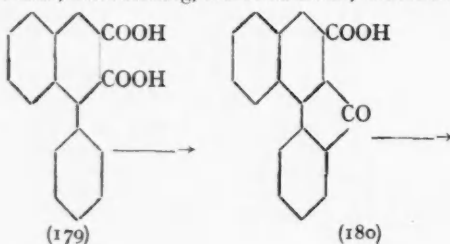


Ultimately it was observed that benzanthrone itself could be prepared by heating anthraquinone with glycerin and concentrated sulphuric acid. This constitutes the first general method for the preparation of intermediates of this class. The anthraquinone (or substituted anthraquinone) is mixed with three times its weight of glycerol and eight times its weight of 98 per cent. sulphuric acid. Stirring is continued throughout the reaction, and the temperature is maintained between 260 – $320^{\circ}C$ (according to the compound used) until the reaction is complete. Isolation is a relatively simple operation, usually consisting in pouring the partly-cooled melt into crushed ice or ice water, when the desired compound separates as an insoluble powder.

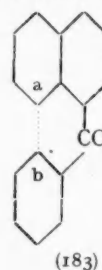
It will have been noticed that in the method just mentioned for the production of benzanthrone, the anthraquinone nucleus is the one started from. Actually, it is cheaper to build up the anthraquinone ring in the final operation, as, for example, in the production of the orange-yellow vat dye and intermediate Anthanthrone (178), which is obtained from 1:1'-dinaphthyl-8:8'-dicarboxylic acid (177). There is a modi-



fication of this reaction, known as the "1:2-dicarboxylic rearrangement," which can be used for the preparation of the carboxylic acids of the series. Thus, if 1-phenyl-2:3-naphthalene dicarboxylic acid (179) is heated with 91 per cent. sulphuric acid, with stirring, for three hours, a benzanthrone



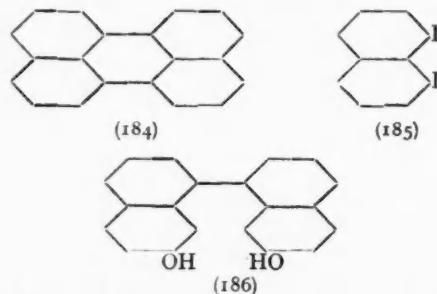
carboxylic acid is produced (182), owing to the formation of the two intermediate compounds (180) and (181). Another very useful method for the formation of benzanthrone is the simple modification of Scholl's Peri reaction, in which α -benzoylnaphthalene (183) or its substituted derivatives are heated with aluminium chloride to $140^{\circ}C$. If there is a free



peri position on the naphthalene nucleus (cf. "a" in 183) ring closure will take place between this and the position ortho to the carbonyl group in the benzoyl nucleus ("b" in 183). The benzanthrone derivatives of this type may be reduced in the hydrosulphite vat to benzanthrols, which have soluble sodium derivatives. In reference to the last method of synthesis of benzanthrone, it is of interest to note that Graebe's "iso-chrysofluorene," which was obtained by the passage of the vapour of benzylnaphthalene through a red-hot tube, is in reality a dihydrobenzanthrene. When benzanthrone is halogenated, the halogen enters the ring most remote from the carbonyl group first.

The Perylenequinones

The hydrocarbon perylene itself is not used in the manufacture of the corresponding quinones, although they can be manufactured from the hydrocarbon by the action of chromic acid mixture in the way previously described for anthraquinone. Perylene itself (184) can be obtained by the classical method of treating 1:8-di-iodonaphthalene (185) with copper bronze. Commercially, it is better to start from β -dinaphthol (186).



The dinaphthol (286 parts) is stirred into anhydrous phosphorus oxychloride, and the mixture warmed to $100^{\circ}C$. To the mixture zinc is slowly added (195 parts), after which the temperature is raised to $200^{\circ}C$ and maintained at that level for some hours. The perylene which is formed is distilled out by heating to about $600^{\circ}C$., when the hydrocarbon is evolved as an orange vapour which condenses into a crystalline mass. This is ground with dilute caustic soda to remove any unchanged dinaphthol, and recrystallised, if necessary, from toluene. It forms yellow plates, m.p. 264 – $265^{\circ}C$., and is soluble in organic solvents with a blue fluorescence.

Dyes and Their Application: Recent Technical Progress

By L. J. Hooley

METHODS of bleaching and scouring do not change much in general outline and it is only in points of detail that alteration takes place. Among these the increasing availability and use of wetting agents is one of the most noticeable features. The number of proprietary products on the market is now considerable, and it is difficult for the user to decide which to adopt, especially as it is not possible to compare them adequately by simple tests. However, there is now an increasing amount of information published describing and comparing the various brands, and detailing the results of practical experience. With the introduction of artificial silk threads into cotton goods milder bleaching treatments have had to be adopted in many cases. Some of the more important of recent results will be given. Dealing first with animal fibres, an interesting summary of the literature of the bleaching of wool by sulphur dioxide is given by E. F. H. Cook (*J.T.I.*, 1926, 371T).

Mechanism of Sulphur Dioxide Bleach

J. L. Raynes (*J.T.I.*, 1927, 379T) has a paper on the bleaching of wool with sulphur dioxide, investigating the suggestion of Gebhard that the bleaching action is due to the conversion of coloured ketonic substances to colourless addition compounds of ester constitution, somewhat similar to "leuco" bodies:



There is support for the theory in the ease with which the bleached wool reverts to its original colour when treated with dilute alkalis or soaps, which is explained as due to the hydrolysis of the ester group. Moreover, when the bleached wool is boiled with water and debleaching occurs, evolution of sulphur dioxide can be detected.

With regard to the evidence for the actual existence of carbonyl groups, the author supports this by the action of hydroxylamine and semicarbazides on wool. By treating wool with these two reagents he shows that a small but quite appreciable rise in nitrogen content is obtained.

The theory that the bleaching action of sulphur dioxide is due to reduction is, of course, both an old one and a natural one, but the mechanism of the reduction has only been vaguely explained, being sometimes put forward as the breaking up of the complex coloured bodies to simpler colourless ones and at other times as the conversion of the coloured substances to soluble derivatives which could thus be removed. This sulphurous ester explanation is, of course, only applicable to the sulphur dioxide and related bleaches, and not to the oxidation bleaches.

Recent Work on Bleaching

One of the most recent of the bleaching agents is perborate. It is rather high in price, but has the advantage that it can be used in hot soap liquors without danger of damaging the fabric. In F.P. 604,600, R. M. Kien uses a 50-60 per cent. solution of perborate (calculated on the weight of the material) for bleaching and desizing raw silk. Lime-free water is used, and the temperature is raised to 70-75° C. during about three hours.

Ferrous sulphate is used as a protecting agent in bleaching animal fibres with hydrogen peroxide (U.S.P. 1,573,200, Stein *et al.*). A bleaching composition which may be used in an iron kier without the formation of rust is made up of sodium silicate, oxalic acid, borax and sodium perborate, according to E. M. Jones, U.S.P. 1,677,283. Iron and copper compounds are stated to have a catalytic action on the bleaching of vegetable fibres with substances of the perborate type. There has been some discussion as to how far the iron and copper salts produce deterioration on vegetable fibres when treated with perborates. The presence of sodium salts of fatty acids is stated to prevent any deleterious action (Y. Dalstrom, *Chem. Zentr.*, 1926, 506).

F.P. 603,253 describes a closed circular chamber apparatus for bleaching wool, silk, jute, etc., with sulphur dioxide, the gas being generated by burning sulphur, and being introduced at the upper end of the chamber and withdrawn through

the lower, with arrangements for efficient distribution (Pollain, F. L.).

In U.S.P. 1,663,952, ground wood-pulp is bleached with a mixture of bisulphite and free sulphurous acid and another acid (A. L. Bragg). Bisulphite is also used in G.P. 415,583 (Greisheim Elektron), where wool is treated in about half per cent. solution for two to five minutes.

Oxidation Bleaches

We come now to the consideration of oxidation bleaches. In the bleaching of animal fibres such as feather, fur, skins, etc., using an alkaline solution of hydrogen peroxide and an oxygen catalyst, addition of the catalyst is made to control the speed of the reaction so that the oxygen is used solely for the bleaching and none of it escapes. Catalysts which are suitable for this purpose are salts of nickel, silver and cobalt. They must not give any precipitate in the bath (Goldarbeiter). Peroxide and chlorine bleaching treatments are combined in G.P. 417,407 (Greisheim Elektron), where bristles are first treated with a solution containing free chlorine and afterwards with peroxide. The process is stated to be quicker, and to give a whiter effect.

With regard to the hypochlorite bleach, R. Bergquist (*Papier Farb.*, 1928, 593) has described a method for determining pH values of bleaching solutions (not an easy operation by simple means such as indicators, for obvious reasons), and has examined the relation between these values and the nature of the bleached product. The theory is put forward that the bleaching depends both on oxidation and chlorination, the extent to which one or both of these take place being governed by the acidity of the bleaching liquor. As the reaction proceeds, the liquor tends to become more alkaline, and an alkaline liquor is more satisfactory for producing the whitest effects. The most effective agent in the bleaching is stated to be the hypochlorite ion, the undissociated acid having little effect, while free chlorine also has a low bleaching action, although it damages the material. In alkaline dye liquors, the hypochlorite ion is in excess, and this is in line with the better effects produced by the alkaline liquors.

The advantages of alkali in hypochlorite bleaching are also made use of in B.P. 286,567 (Taylor, C.). This is effected by bleaching with hypochlorites or chlorine gas in the presence of an alkaline carbonate, while also it is of advantage to add a weak alkali such as borax or ammonia. The goods are kept in this liquor for 12 hours, when they are found to have suffered little damage and to dye in more level shades than before treatment.

For cotton and linen goods, partly dyed with vat colours, which have to be bleached, a previous boiling treatment with sodium silicate or sodium carbonate under pressure at 120° C. is stated to prevent the colour being affected during the bleaching treatment (U.S.P. 1,558,104, McDowell, J. C.).

An improved method of carrying out desulphurising, bleaching and other treatments with artificial fibres from cellulose consists in carrying out the treatment while the material is wound on the bobbin (Herminghaus and Co.). Further new use for cyclohexanone and its homologues is for the degreasing of raw wool. It may be used either alone or admixed with other water-soluble solvents.

Mercerisation

For the mercerisation of cotton goods containing desulphurised viscose silk, caustic potash is stated to be superior to caustic soda, as the lustre, strength and handle of the material are hardly affected to a noticeable extent. When potash is used, the material is mercerised in caustic potash of specific gravity 1.3 at 30° C., stretched, washed and finished as usual, the whole procedure only occupying about one minute (B.P. 295,488, Silver Springs Bleaching and Dyeing Co., and A. J. Hall). Another modified mercerisation process consists in washing the material free from alkali by means of comparatively large quantities of water, preferably warm. This process is used after mercerising cotton materials containing cuprammonium or viscose silks, using caustic soda as the mercerising agent.

Dyestuffs Markets: The Month's Business in Review*From Our Own Correspondents***Yorkshire**

DESPITE the optimism displayed by Chambers of Commerce and the daily press, turnovers this year have been less than those of last year over the corresponding quarter. Prices are still lower, but weights have undoubtedly increased, which on the surface would appear to be a very satisfactory state of affairs were it not for the reduced turnovers.

An underlying, unsatisfactory, and disturbing feature is that the unreasonable drop in prices and consequently in cash turnover is due to what is regarded as not quite legitimate competition but a commercially-political move to oust competition. The dyemaker's primary raw material, crude benzol, has again responded to the recent increase in the price of petrol—the second within twelve months. Whereas prior to the Government's Budget of last year crude benzol could be bought for ninepence a gallon it is now about thirteenthpence halfpenny, and the drop in prices of dyestuffs since January 1 of this year averages between 20 per cent. and 25 per cent. This sort of thing is not calculated to help the British dyestuff industry. It is to be hoped that the next Budget will afford relief to the petrol consumer by way of reducing or abolishing the tax and giving indirect relief to the much-harassed maker of dyestuffs by thus causing the inflated prices of benzol to become deflated.

It will be realised that the high price of crude benzol not only affects the cost of production of benzene derivatives but those of toluene and xylene also. The markets for pure benzene, toluene, and xylene are very firm, particularly for the last two. The price of xylene, however, is held somewhat in check by the competition of white spirit for the cellulose lacquer trade. The British intermediate manufacturers have always done a fairly extensive export business in nitrobenzene, but although they are holding their own, it is difficult and a struggle, on account of the higher cost of pure benzene. True, the continental price of crude has advanced, but not more than 2d. per gallon against 4½d. to 5½d. per gallon in Great Britain.

A little liveliness exists amongst labour in the heavy woollen district in consequence of six of the largest woollen cloth

manufacturing firms giving notice of a 10 per cent. reduction in the basic rate of wages of all grades of textile workers, to become effective on the second pay-day in April. The firms concerned are T. and J. Taylor, Ltd., G. and J. Stubby, Ltd., M. Oldroyd and Sons, Ltd., H. Hamer and Sons, Ltd., Joseph Newsome and Sons, Ltd., and C. Robinson and Sons, Ltd. A leading manufacturer in the district has stated that a reduction is absolutely inevitable; firms cannot go on under existing conditions. His particular concern, he said, was sorry enough to have to do it, but it could not be helped, and it was for the employees to show a willingness to help employers to get over a very serious period of trade losses.

Scotland

Trade in Scotland on the whole has remained fairly good during the month. After the exceptionally severe weather of a few weeks ago, the present remarkably spring-like conditions for Scotland have not been without a good effect on trade, and the dyeing and cleaning branches especially have benefited.

In the Glasgow and Paisley districts workers have been fairly fully employed, and although orders are tending to fall off at the moment there is still a good deal of full time.

Calico printers also have a fair amount of work on hand, although this branch is somewhat patchy, varying from district to district. The carpet trade is fairly active, and wool dyers have a moderate amount of work.

The tweed trade is still a little below previous years, and although there has been a revival in repeat orders for the present season, confirmations of next winter's orders are coming in rather slowly. A good deal of business which has been done is with Europe and America, and the home side is rather dull.

The authorities at Balloch have passed the plans for the new silk factory. The silk works at Jedburgh are practically complete, and it is anticipated that they will absorb most of the district's unemployed.

At Grangemouth, Scottish Dyes' new offices and laboratories are reported to be completed.

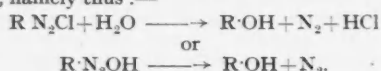
Photographic Printing*Uses of Diazo Compounds*

THE photochemical decomposition of the diazo compounds is the basis for certain photographic printing processes—the so-called diazo type processes—which are particularly useful in printing tracings of mechanical drawings, because a positive print is obtained direct from the positive, enabling a print from a tracing to be obtained with dark lines on a white background.

A film comprising a diazo compound, upon exposure to light under a transparent original, forms decomposition products in the transparent parts, while the protected parts leave an unaltered diazo compound. The print is now developed in a solution comprising an azo dyestuff component as developer. The parts where diazo compound is to be found (the lines in a mechanical tracing) yield with the diazo dyestuff component a dye, while the decomposed parts give no reaction. After developing, the process is theoretically complete, the picture being permanent. As a matter of practice, however, the print is preferably washed, because any diazo compound remaining in the exposed parts causes a certain discoloration of such parts by reacting with the decomposition products.

Nature of the Decomposition

The normal decomposition product of the diazo compound is a phenol, which is formed in the same way as by heating the compound, namely thus:—



There is sufficient moisture in the paper to supply the water required for the first equation. The formation of phenols, however, is not desirable, because phenols in particular cause considerable discoloration of the white background, and it is

therefore important if possible to form some other substance as the decomposition product. This may be accomplished in the same way as would be done in the case of a thermochemical reaction in the dark.

For instance, conditions can be selected suitable for the Sandmeyer reaction (*Ber.*, 17, 1633, 2650; 18, 1492, 1496; 23, 1880), and a halogen substitution product can be obtained. Accordingly, cuprous chloride or cuprous bromide, etc., may be added to the diazo compound in the sensitised layer. Similarly, cyanogen, cyano, thiocyan, selenocyan and other substitution products may be obtained more or less quantitatively by adding cuprous salts and other substances to the diazo layer. Furthermore, sulphur, hydrogen, sulphonic acid, acetoxy groups, etc., can be substituted.

So far as research on this subject has been done, it is not possible to give accurate details of the processes, but experiments have shown that the background of the diazo prints can be considerably improved by the measures outlined.

Dyestuff Licences for March

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during March, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 618, of which 549 were from merchants or importers. To these should be added 11 cases outstanding on February 28, making a total for the month of 629. These were dealt with as follows:—Granted, 575 (of which 554 were dealt with within seven days of receipt); referred to British makers of similar products, 40 (of which 32 were dealt with within seven days of receipt); outstanding on March 30, 14. Of the total of 629 applications received, 586 or 93 per cent. were dealt with within seven days of receipt.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

Dye Price Factor Reduced

THE announcement is made in the *Manchester Guardian Commercial* that the Dyestuffs' Advisory Licensing Committee has decided that, as from this week, the price factor for British dyes is to be reduced to 1.75. This factor was at first fixed at 3. It was reduced to 2½ in March 1925, to 2 in September 1927, and it now stands at 1.75. This means that a British dye must now cost 75 per cent. more than the pre-war foreign equivalent before an import licence will be granted.

New Scottish Dyes

Imperial Chemical Industries, Ltd., announce the production by Scottish Dyes, Ltd., of Grangemouth, of two important new additions to their Duranol range of colours, namely, Duranol Brown R. and Duranol Brown G. These colours are designed to meet the need for fast browns for acetyl silk and will be of especial interest and value for current fashion shades. They have the usual excellent dyeing properties of this well-known series, the R. brand being well up to the average of the series in fastness to light, while the G. brand is slightly below this. The colours look extremely well on the rather loose yarns selected for their exhibition, and considerable variety of shade is produced by the three different strengths of the dye-baths—1 per cent., 5 per cent., and 10 per cent.

Sir Max's Retirement

Sir Max Muspratt, whose recent bereavement has brought him the sympathy of the whole chemical industry, has resigned his membership of the Dyestuffs Industry Development Committee, which is now engaged in preparing a report of the operation of the Act. The Board of Trade, on the nomination of the Association of British Chemical Manufacturers, have appointed as his successor Mr. T. M. Willcox, of the British Alizarine Co., Ltd., a company that was formerly represented on the Committee by the late Mr. W. H. Dawson.

Dyestuffs Prices

Mr. F. W. Astbury, a Lancashire Member of Parliament, has been dealing once more with the contention that owing to the alleged high prices of British dyes cloth is sent abroad to be dyed or otherwise treated and brought back for sale in the home market. This practice, he says, was certainly indulged in for many years before the war, owing to Belgium paying low wages and working long hours, and thus being able to produce her goods below our own cost of production. "As a large calico printer," Mr. Astbury adds, "I may state that since the war I have never bought any German dyes, for the reason that I can purchase those dyes in this country and from Switzerland at a price which has not raised the cost of my production above that before the war." He reminds us, too, of the period between 1914 and 1918 when, if it had not been for the British Alizarine Co., the whole of our print works would have been closed down.

Artificial Wool

A new form of artificial wool, produced from a waste vegetable material and changed by a "secret chemical process" into a fibre, was exhibited in London this week. The fibre, known as N.T. (Nouveau Textile), is the discovery of a Frenchman, M. Joseph Viallet. The world rights have been taken over by a British company, of

which Captain Ash, formerly of S. and L. Ash Brothers, woollen merchants, of Leeds, is joint managing director with the inventor. The company state that the fibre is not to be regarded as a rival but as an ally of natural wool, and their view is that, used in association with the natural article, it will open up new markets and will be used by those who have been debarred hitherto from the use of woollen goods owing to their cost. Samples of the N.T. artificial wool, which has much the appearance of ordinary wool, were shown together with a variety of finished articles.

The Continental Negotiations

Though the fact that the German, French and Swiss dyestuff makers have come to some sort of understanding is quite definite, very little is known of the conditions and details of the arrangements arrived at. At the annual general meeting of the Society for Chemical Industry in Basle, which took place on Thursday, April 26, the president, Dr. J. Brodbeck-Sandreuter, appears (from a long article in the *National Zeitung*) to have devoted a large part of his speech to an account of the negotiations which had taken place. The three interested parties, he said, were the German I.G. Farbenindustrie A.-G., the French dyestuff group, and a Swiss group described as the Basle I.G. This latter is simply a group of Swiss manufacturers, having no connection with the German I.G. or with the Swiss offshoot of the latter, the I.G. Chemie Basle.

The Agreement

The agreement between the three parties, according to Dr. Brodbeck-Sandreuter, is connected purely with sales. The Swiss group, he insists, remains entirely independent, its selling organisations being kept intact, and its free technical and commercial development being assured. Reports of a fusion of selling organisations are described as untrue. While withholding details of the negotiations and their results, on the ground that such agreements are confidential, Dr. Brodbeck-Sandreuter states that there is no intention of forming a trust, that capital combinations are ruled out and that there will be no pooling of profits. The arrangements are not directed against consumers.

Dr. Brodbeck-Sandreuter points out that even before the war conventions or understandings with regard to some classes of dyestuffs existed, and that some years ago, after the war, such arrangements were again mooted. The object of the negotiations between the German, Swiss and French groups was to restore the dyestuff market to a healthier condition, and to obviate unnecessary (and often very harmful) competition. The negotiations have been long and difficult, having occupied more than five years—a sufficient indication of their delicacy. The object of the negotiations and of the agreement resulting from them is the stabilisation and consolidation of the dyestuff industry. The agreement does not apply to the United States, which remains a "free" market.

Reference to Great Britain

It is significant that Dr. Brodbeck-Sandreuter regards the present agreement as the prelude to other still wider ones with other parties. The agreement, he says, is not directed offensively against the outside producers. As far as European producers are concerned, he hopes that negotiations with the British group (presumably I.C.I.),

which for the time being have led to a negative result, will be resumed, in order to draw the latter into the agreement. [The negotiations to which reference is made are presumably those which took place with the British Dyestuff Corporation some years ago.]

United States Increased Imports of Dyes

Imports of synthetic dyes for consumption in the United States during March totalled 766,786 lb. valued at \$612,253, bringing the three months' total up to 1,710,271 lb., value \$1,368,272. An increase of 34 per cent. in weight and 32 per cent. in value is registered during the first quarter of 1929 over the same period in 1928, when 1,271,751 lb. having an invoice value of \$1,034,682, were entered. Germany supplied 73 per cent. and Switzerland 23 per cent. of the January-March, 1929, imports, while in January-March, 1928, Germany furnished 59 per cent. of incoming shipments and Switzerland 29 per cent.

American "Fastness" Attacked

Considerable agitation has been caused among American dyestuff firms by an attack on the quality of home dyes in the matter of fastness by a New York dress manufacturer, who suggested that it might be necessary to return to German dyes, if the American makers were not careful. The attack is being met with great vigour. The president of the U.S. Finishing Co. declares emphatically that there is nothing wrong with American dyes; the trouble is the buyers' desire for cheap fabrics. This is confirmed by several trade and technical authorities, who contend that the American dye industry is producing dyes second to none in point of fastness. The whole problem comes down to a question of price. A further retort is that in America "there are too many salesgirls who have an inferiority complex when it comes to goods that have been dyed or printed with American colours."

Progress of Vat Dyes

The outstanding features of American dye production in 1928, according to a preliminary survey issued by the United States Tariff Commission in connection with its annual Census of Dyes, were the increase in the production of vat and other fast dyes, the production of many new fast and speciality dyes, the reduction in the number of domestic manufacturers from fifty-five to forty-seven, the increase in unit price of sales of all dyes, the increase both in exports and imports. The production of vat dyes established a new record with a total of more than 6,300,000 lb., as compared with 5,061,688 lb. in 1927. Before the war there was no production of vat dyes in the United States, and the entire supply was imported from Germany and Switzerland. The increased consumption of vat colours indicates that the American public realise that although the fast dye is more expensive, the cost of dye per yard of fabric or per garment is, in general, a small fraction of the total cost, and that it is more economical to invest in fast-dyed fabrics or garments.

A Japanese Dye Subsidy

Further Government aid to industry has been reflected in a move by the Japanese Ministry of Commerce and Industry to secure legislation during the present session of the Diet granting subsidy to the artificial indigo industry for production on a larger scale than at present. An annual production of 1,000 tons is desired for domestic demand, and it is planned to increase this to 3,000 tons with a view of exporting the surplus to China. The recommendation made by the Industrial Chemical Society of Japan to the Government in favour of the subsidy is in the following terms:—

"Artificial indigo constitutes one-third of the imported dyestuffs, and its tonnage leads the list of all dyestuffs. Six manufacturers in this country have expended many

years of strenuous effort and an enormous amount of money in studying the methods of its manufacture. They are, however, in a position where Government subsidies are required to enable them to stand against imported articles. There is no doubt that the establishment of independent artificial indigo manufacturing will greatly improve the nation's dyestuffs industry in general. We wish the Government to give its due consideration to the protection of this important centre of the chemical industry of Japan."

American Summer Shades

The smartest summer colour this year in American dress fabrics promises to be Capucine, taken from the brilliant tones of the familiar nasturtium. The Textile Colour Card Association has decided on three of these golden orange tones—pale capucine, a delicate orangy beige, with a glowing undertone; golden capucine, a radiant noontime colour; and brilliant capucine, the most intense tone of the three, a very gorgeous hue. Not only in frocks will the nasturtium colours be seen. They will be worn in shoes, hats, and all accessories. The Association also shows three new pastel colours—opaque green, a subtle greyed green tone; rosedew, a morning rose, not yet sun-dried, with a glistening delicacy; and bleu d'amour, a crayon blue slightly violet tinted. The gay and vivid tones will include a luminous new yellow named Nugold and a bright green called Tipperary. Royal Violet, a bright rich pansy colour, is considered smart, and Bleu Moderne, an intense and brilliant blue, will be popular, both for daytime and evening costumes. Another orange-red which will come into its own with the lengthening days is Diabolo Red, while the other new summer colour, Grande Chartreuse, is already attracting notice. These colours are all adaptable for sports, daytime frocks and evening wear, or any accessory, and the season will see many an interesting combination of them.

Dyers and Cleaners' Good Year

At the ordinary general meeting of the Associated Dyers and Cleaners, Ltd., the chairman (Mr. Frank Eastman) expressed the view that the trade had been unfairly treated by the Chancellor of the Exchequer in the matter of spirit. In common, he remarked, with other users of motor transport, they had to bear their share of increased taxation on petrol, but to have to pay in addition a duty on their principal raw material for dry cleaning—namely, cleaning spirit—was quite unjust. Strong representations were made to the Chancellor, and the matter was ventilated in the House of Commons without due consideration being given to their plea for exemption from the petrol tax, which still continued to be a very heavy burden on the industry. The suggestion made was that the trade should pass the tax on to their customers. This they could not do because their charges not only were based on the cost of doing the work but must also bear some relation to the value of new goods.

Expanding Business

As an example of the development of the business, the chairman mentioned that during the year they had opened fifteen new branches throughout the country. The business was still growing apace, and he was optimistic as to the future. Unfortunately, owing to the severe weather early this year trade was not good, but during recent weeks business had considerably improved, and they were having an extraordinarily good spring cleaning season. They were looking forward to a good year's trade, and believed that they were well equipped to meet the growing demands of the public, who realised increasingly the valuable services which could be given by a dyer and cleaner. The final dividend declared made a total for the year of 10 per cent., with a bonus of 2½ per cent.

Rayon : Growth and Development of a Great Industry

By A. B. Shearer

We reproduce below the paper on "Rayon" (artificial silk), read by Mr. A. B. Shearer (of Courtaulds, Ltd.) at a meeting of the British Science Guild at the Mansion House, London, on Wednesday, April 24.

As there is a great deal of misunderstanding as to what is rayon, or, as some people still call it, "artificial silk," a definition is necessary. Rayon is "the generic name of filaments made from various solutions of modified cellulose by pressing or drawing the cellulose solution through an orifice and solidifying it in the form of a filament, or filaments, by means of some precipitating medium." "Artificial silk" is quite the wrong name to call this wonderful new textile, as it is no more "artificial" than are steel and many other manufactured products and it has none of the chemical and few of the physical characteristics of silk. The use of the expression "artificial silk" only keeps alive an erroneous impression of inferiority. All textile materials are named by short words, and it was for that reason that the word "rayon" was introduced for the new textile industry, which is already more than three times the size of the old silk industry, and to-day ranks only after cotton and wool in importance. The four principal processes vary greatly in their chemical reactions and the machinery employed but they are all alike in the fundamental principle of producing a solution of cellulose, pumping the solution through fine holes or jets and, as it emerges, precipitating or coagulating the cellulose into continuous solid filaments or fibres.

Four Processes of Manufacture

In order of their industrial development the four processes are :—

- (1) Nitrocellulose.
- (2) Cuprammonium.
- (3) Viscose.
- (4) Cellulose acetate.

Nitrocellulose was first used to produce a continuous thread by Sir Joseph Swan in 1883 when he made his "artificial silk" for use as filaments in his gas filled electric lamps, but Swan fully realised the textile value of his filaments, and in 1885 exhibited in London fabrics made from his yarns. This was a year before Count Hilaire de Chardonnet took out his patent, so that Chardonnet's chief claim to fame is not as the first inventor but as the first producer of rayon for textile purposes by establishing works in France, Switzerland, Belgium, and England. In this process the cellulose (usually cotton) is nitrated with a mixture of sulphuric and nitric acids. The cellulose nitrate is dissolved in a mixture of alcohol and ether and the resulting solution is spun either dry, that is into air, or wet, in which case coagulation takes place in a water or salt bath. The resulting threads are afterwards denitrated with either sodium or calcium hydrosulphide. Owing to the expense of this process it is used to-day to a diminishing extent.

The cuprammonium process, based upon Schweizer's discovery of 1837, was first used to produce filaments by Weston in 1882, but it was not developed commercially until after Pauly patented his process in 1897. In this process the cellulose, again usually cotton, is dissolved in "Schweizer's reagent," or ammoniacal cupric oxide solution. The resulting solution is then spun into a solution of caustic soda and the resulting filaments are usually stretched to increase the fineness and strength of the yarn. The copper is afterwards removed by washing the yarn with dilute sulphuric acid. This process is still used to a limited extent, especially for the production of fine denier yarns.

Viscose

In 1892, Cross and Bevan, who had been systematically investigating cellulose reactions since 1880, discovered, and patented, a method of forming a solution of cellulose which they called "viscose" because of its distinctive characteristic. This discovery only became industrially valuable after Topham, experimenting with Stern, discovered the effects of ageing and invented his method of spinning by means of a centrifuge. In this process cellulose (which can be either wood pulp or cotton) is steeped in a strong solution of caustic soda and the resulting alkali cellulose is treated with carbon bisulphide, which converts it into cellulose xanthate,

a reddish gelatinous substance, soluble in water. The solution of cellulose xanthate, or viscose, after "ageing," to bring the solution down to the correct viscosity for squirting through the spinning nozzles, is coagulated in an acid bath. This is by far the most important process to-day and probably represents about 85 per cent. of the world's rayon production. It is generally considered that future developments will result from modifications and improvements of the viscose process.

The cellulose acetate process is quite unlike the other processes because the resulting yarn is a compound of cellulose, whereas all the other yarns are pure degraded cellulose with only slightly different physical characteristics resulting from their processes of manufacture. Cross and Bevan patented a process for cellulose acetate manufacture in 1894, but although it was investigated experimentally it achieved no practical success. Little in 1895 produced lamp filament from cellulose acetate and Bronnert in 1899 made yarns experimentally, but it was Miles who in 1904 produced a cellulose acetate soluble in acetone and several other solvents, which prepared the way for the later industrial elaborations. Since the war a number of works have been established to produce cellulose acetate yarns, but the production is still a relatively small one. The cellulose is first acetylated with acetic anhydride and acetic acid in the presence of a catalyst such as sulphuric acid. The chloroform-soluble cellulose acetate which results is not sufficiently strong for rayon. If water, however, is added to the reaction solution, and this is allowed to stand, a "ripening" takes place in which the cellulose acetate becomes degraded and then yields a secondary cellulose acetate soluble in acetone, in which solvent it is used for rayon manufacture. The resulting spinning solution may be spun, like cellulose nitrate, either by wet or dry processes.

Reactions on the Chemical Industry

In a short lecture a detailed description of the industrial methods employed in these four processes cannot be given, but enough has been said to indicate that their development upon a huge industrial scale must have had important reactions upon the chemical industry, especially in the production of sulphuric acid, carbon bisulphide, hydrochloric acid, caustic soda, sodium sulphide, acetic acid, acetic anhydride, copper sulphate and dyestuffs. Engineering has also been stimulated, especially in making improvements in filtration, pumping, ventilation, and power transmission.

The manufacture of rayon is only possible as a result of the scientific developments of the last hundred years, but it owes more to science for its amazing growth than has so far been indicated. The names of Swan, Weston, Cross, Topham, Chardonnet, Stern, Pauly, and others are generally associated with the establishment of rayon production, but most people would be surprised if the names of Macadam, Watt, Dalton, Faraday, Perkin, Bessemer, Bell, Edison, Otto, and Northcliffe were suggested as having an important influence in developing the rayon industry. The reason these names are suggested is not because rayon could not be produced without the discoveries of at least four of the men mentioned but rather because our physical and mental environments which have resulted from their efforts have made rayon a necessity. The changes made have been more revolutionary for women than for men, and consequently it is women who have been the first and greatest consumers of rayon. It is unnecessary to give more than a few of the effects of the discoveries that are indicated by the names given, but in the main one can say that the last hundred and fifty years have seen the change over from primitive hand to modern chemico-mechanical production with a consequent enormous increase in real wealth spread through the community. Methods of transport have been enormously improved, so that instead of the few travelling on horseback by muddy or dusty tracks, the masses to-day journey in comfortable, well-heated railway carriages or in closed road motors. Houses, offices, factories, hotels, theatres, cinemas, and dance halls

are also so well heated, lighted, and ventilated that we are to-day surrounded with a sub-tropical climate. Rapid movement and this warm atmosphere have compelled a reduction in the weight of our clothing, and women especially, because of their greater mobility, have demanded greater freedom in the design of their clothing. Education, sport and dancing have played their part and the cumulative result has been a demand for fewer, shorter, lighter and brighter clothes. Such a demand could not be met by the older natural fibres, as the only suitable textile was silk and that could not be economically produced at a price to meet the new demand. A new textile was necessary which would be at least as beautiful as silk and yet be capable of production in enormous quantities at a price which would make it possible for all women to obtain it. The growth of the use of rayon need not be given in detail, but to-day almost every item of clothing used by women and girls, from shoes to hats, contains a greater or less quantity of rayon. Two main uses should be mentioned—hose and underwear. Short frocks make good-looking hose a necessity. With a reduction in bulk of clothing, frictionless, close-fitting underwear that can be easily washed and laundered is essential, and rayon is the only textile which fulfils these requirements. The result has been that for foundation garments rayon is now everywhere recognised as the standard material. These garments are mainly the product of the knitting industry, and the introduction of rayon has caused a surprising growth in that section of textile manufacture, a growth which has not yet reached its limit of development.

Industrial Aspect

The industrial development of rayon has been quite as interesting as the laboratory discoveries which have been briefly described. Unfortunately this phase of the growth of an industry is not represented by patents and other public records, and consequently much of the early history of the industry will certainly be lost. Many tried but few succeeded, and the few who finally triumphed were those who went forward with complete faith in a wonderful new textile material which they were determined at all costs to produce upon a commercial scale. Only those who succeeded are remembered, the many failures were never known to more than a few. Even to-day, after a passage of nearly forty years, the number of really successful firms is small. The difficulties of establishing an entirely new industry are seldom realised. It is not merely a question of selecting a convenient site and ordering your buildings and machinery. In a new industry laboratory formulae have to be carefully extended for large scale production and methods of industrial application carefully thought out. Suitable machinery has to be designed, in many cases embodying entirely new principles. It must be placed to the credit of British organisation, business foresight, engineering skill, textile technology and salesmanship, that this country has been able to take and maintain the lead in this great new industry. It was not only a question of producing a yarn that would hold together; the physical and chemical properties had to be investigated and developed to conform to the specific needs of various sections of the textile industry. The underlying idea in this country has always been that quality must always be improved, and only those who have had experience in the use of the early products can fully appreciate how far ahead are the present yarns.

The specialities of to-day are usually the standard products of to-morrow. Something of the technical developments that have taken place can be judged from the fact that rayon yarns can be produced that are two to three times stronger than the average yarn now in general use. The fineness of rayon yarns, especially of the filaments or fibres of which they are constructed, has improved to an amazing extent during the past few years. To-day it is possible to produce commercially rayon yarns as fine as the finest silk and far finer than cotton. A pound weight of the finest denier yarn spun to-day contains about a hundred and seventy miles, and filaments have been produced which are so fine that one pound would extend to over five thousand miles. These rayon filaments are far finer than those spun by any silkworm.

The use of rayon has had an astonishing effect upon the general condition of the textile industries. The introduction of a new material has demanded a review of methods and has acted as a stimulus to those engaged in every branch. Especially has this been noticeable in bleaching, dyeing and

printing. The new material has demanded better finishes than were given to the older textiles, and the result is that the whole industry has benefited from the improved methods and the better colours which are now available. There has also been a noticeable improvement in the production of new and finer fabrics. The workers themselves have changed for the better. Rayon requires more delicate treatment, manually as well as mechanically; excessive humidity is no longer an advantage but a detriment; and in the production of the new fabrics cleanliness is essential. All these new conditions have altered the environment in which textile operations are now carried out and these changes have in every case benefited the worker.

No official figures of employment in rayon production are available, so that only estimates can be given. In the actual production of rayon about 25,000 workers are now directly engaged, but to this must be added engineers constructing the machinery, chemical workers producing the raw materials and the far greater numbers engaged in processing the yarn for manufacture, weaving, knitting, dyeing and finishing, and making-up for sale. If all these are included, the number of workpeople in the British Isles dependent upon the rayon industry is probably at least 300,000.

A Truly National Industry

There is another important economic consideration. Since 1924 (the duties were introduced in 1925), the production has doubled and in 1928 exceeded fifty million pounds weight. In this same period the imports fell from 10,318,000 lb. in 1924 to 2,883,000 lb. in 1928. The increased development in that short time has more than equalled the production attained during the previous eighteen years since the establishment of the industry in this country. As there is now a more or less definite ratio of workers to production this signifies that employment has doubled in a period of about three years. One other phase should be mentioned. All the cotton and silk we use is imported, as is also at least 85 per cent. of the wool. Of the cost of yarn production in silk 100 per cent., and in wool and cotton from 50 to 60 per cent., is represented in imported materials. By contrast with these yarns the bulk of rayon produced in this country is 100 per cent. British, as approximately 95 per cent. of the cost is expended in this country and the balance is chiefly accounted for in purchases from Canada of wood pulp.

Rayon is essentially the textile of the chemico-mechanical age we are now entering, and there is every indication that in the future, as in the past, this country will play its appropriate part in the industry.

Dyestuff Licences for April

THE following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during April, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 734, of which 652 were from merchants or importers. To these should be added 14 cases outstanding on March 30, making a total for the month of 748. These were dealt with as follows:—Granted, 700 (of which 686 were dealt with within 7 days of receipt). Referred to British makers of similar products, 36 (of which 23 were dealt with within 7 days of receipt); outstanding on April 30, 12. Of the total of 748 applications received, 709 or 95 per cent. were dealt with within 7 days of receipt.

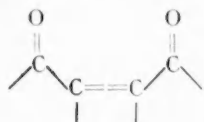
Consolidation of Czechoslovakian Dye Industry

APPROVAL has been given by the Czechoslovak Government to the organisation of the Czechoslovak Consolidated Dye Co., a joint stock company which will be formed by a merger of the Czechoslovak dye factories at Aussig, Braunau, Roehltitz, and Liberec (Reichenberg), with the Joint Dye Works of Vienna. The shares of the Austrian company are now owned by the Dyeing and Printing Joint Stock Co. in Chur, Switzerland, with which are affiliated the Hungarian Textile Dyeing Co., Budapest, the Budapest Wool Manufacturing Co., and the Textile Printing Co., in Naefels, Switzerland. The headquarters of the Czechoslovak company will be in Liberec (Reichenberg).

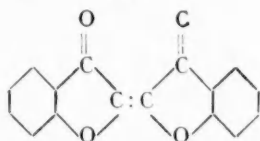
Dyes and Their Application : Recent Technical Progress

By L. J. Hooley

Of the many ring structures containing the grouping

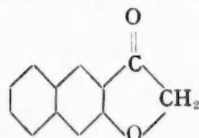


which comprise the indigos, the nearest analogues to indigo are those in which each of its two $>NH$ linkages is replaced by $>S$ or by $>O$. Those containing $>S$ form the well-known and technically important thioindigos while those containing $>O$ are relatively unimportant. The simplest one is oxindigo or 2 : 2'-bis-coumarone-indigo,

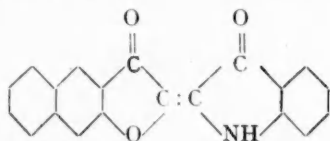


It was discovered by Fries and Hasselbach five years after Friedlaender had synthesised thioindigo. 2-Coumaranone itself does not give the indigo on oxidation, and it was necessary to synthesise the colouring matter by Sachs's method, *i.e.*, by condensing one molecule of the coumaranone with one molecule of its *p*-nitrosodimethylaniline compound. The dye gives a bright yellow colour, as compared with the red of thioindigo, which is in conformity with the general relative chromophoric power of these two elements. Unlike indigo, oxindigo and its analogues have not found technical application. One reason for this is that alkali has a hydrolysing action, resulting in the opening of the ring, so that the substances cannot be vatted with hydrosulphite and alkali.

Recently, however, these coumarone indigo series have appeared likely to increase in importance, as according to D. R. P. Appln. J. 29,350 certain selected benzocoumaranones have been obtained which give dyes stable to alkalies, and which may be vatted and dyed on animal and vegetable fibres. These derivatives are obtained by condensing the benzocoumaranone of the following general formula :



with 2-derivatives of isatin, 2,3-diketodihydrothionaphthenes, coumaranones, penthiophenes, etc. The product obtained by condensing with isatin anilide, and having the formula below, dyes in red-violet shades.



Methyl-halogen-thioindigos

As is known, the effect of substitution in the indigo series is made use of not only for altering the shade but for improving fastness. The effects vary considerably with the nature and position of the substituents introduced. Methyl and chloro-methyl derivatives of thioindigo have obtained importance because of their higher fastness to light than thioindigo itself.

In B.P. 279,489 (I.G.F.A.-G.), special claims are made for 4,4'-dimethylthioindigo, which is stated to surpass in fastness the higher substituted thioindigo dyestuffs containing also substituents in the 4-positions.

Like the bulk of the thioindigos, this can be obtained via a

thioglycollic acid, in this case 3-methylbenzene-1-thioglycollic acid having as substituent in the 2-position a group which may be $-CN$, $-CONH_2$ or $-COOH$. The ring is closed to form an oxythionaphthene, for example, by treating with alkali, and this thio-naphthene oxidised : alternatively it may be condensed with diketones instead.

A large number of other thioglycollic acids have recently been described for use in synthesising similar substituted thioindigos, especially the halogen-methyl ones ; thus in B.P. 295,593 (I.G.F.A.-G.), 1-methyl-2-amino-3-nitro-5-halogenobenzene is condensed by way of the corresponding 2-cyano-3-nitro-, 2-cyano-3-amino- and 2-cyano-3-diazonium compounds to the 2-cyano-3-methyl-5-halogeno-1-thioglycollic acid. This is then used for the production of 4-methyl-6-halogeno-3-oxythionaphthene.

In B.P. 295,694 (I.G.F.A.-G.), the thioglycollic acids containing carboxylic amide groups in the *o*-position are obtained by hydrolysing corresponding nitriles with hydrogen peroxide in alkaline solution. Further alkaline treatment converts the acids to oxythionaphthenes. An example describes the production of 6-ethoxy-hydroxythionaphthene from 2-cyano-5-ethoxybenzene-1-thioglycollic acid.

Another method of preparing thioglycollic acids is described in B.P. 281,290 (I.G.F.A.-G.), halogeno-alkylbenzenes being condensed with chloresulphonic acid below $100^\circ C$, the sulphochlorides reduced to mercaptans, and these condensed with chloracetic acid.



The chloresulphonation stage goes very smoothly giving single products. *m*-Chlorotoluene takes the sulphochloride group in the *p*-position to give 1-methyl-5-chlorobenzene-2-sulphochloride. The process is stated to be more satisfactory than the commoner one, in which the mercaptan group is obtained from the amine by forming the xanthogenic ester according to Leukhardt's method.

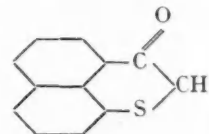
Another example of the production of hydroxythionaphthenes from thioglycollic acids is described in B.P. 288,986 (I.G.F.A.-G.).

Alkoxythionaphthenes

Another valuable group for thioindigos is the alkoxy group. In B.P. 291,361 (I.G.F.A.-G.), 4:6-dialkoxyphenyl- and 4:6-dialkoxy-5-halogenophenyl-1-thioglycollic-2-carboxylic acids are prepared from 3:5-dihydroxy- and 3:5-dihydroxy-4-halogenobenzoic acids. After alkylation the thioglycollic acid group is introduced via a nitro-group. Ring-closure to thionaphthenes may be effected by alkaline condensing agents, or where there is not a carboxylic acid group in addition to the thioglycollic acid one, by converting to the acid chloride and treating with aluminium chloride (B.P. 298,493, I.G.F.A.-G.).

peri-Naphthoxypenthiophenes

Analogous to the oxythionaphthenes are the *peri*-naphthoxypenthiophenes (or *perinaphthathioindoxyls*), the latter differing from the former by containing an additional benzene ring, while the $-COCH_2S-$ being fused between *peri*- instead of *ortho*-positions forms a six instead of a five ring, thus :



This has considerable colouring power ; thus by substituting this for one half of the thioindigo molecule, the shade changes right over from red to blue. Examples are to be found in B.P. 275,292 (I.G.F.A.-G.), and in U.S.P. 1,613,275 and 1,623,410 (Grasselli).

In a sealed note (24.11.09) recently reported, M. Baumann synthesises Thioindigo Scarlet on the fibre from phenylthioglycine-*o*-carboxylic acid and isatin bisulphite. The goods are padded with this mixture and steamed, borax being used as the alkali, since sodium carbonate is liable to form the dyestuff prematurely in the solution.

Indigo Discharges

In other sealed notes, Haller and Vaucher (18.9.08) obtain green discharges on an indigo ground with Acridine Yellow and Methylene Blue, printing with Rongalite, aniline and tannic acid. Vosnessenski (2.9.09 and 18.10.09) finds that certain catalysts, e.g., sulphites and nitrites, are of great

advantage in the nitrate discharge of indigo, as by their use much lower concentrations suffice. The same author (7.7.05, 20.7.05) obtains yellow and orange discharges by means of the nitrosamines of dichloroaniline and *p*-nitro-*o*-anisidine. Reports on all the above-mentioned notes are to be found in *Bull. Soc. Ind. Mulhouse*.

Recent Research into Colour Fastness

The Work of the Woollen and Worsted Research Association

In the annual report of the British Research Association for the Woollen and Worsted Industries, there is an interesting account of the work of the Colour Department. The main activity of this department is the setting up of standard tests for fastness of dyestuffs on dyed fabrics to light, washing, perspiration and other agents. It is recognised that no test can succeed unless it rests on a secure scientific foundation, so that much of the work is directed towards a critical examination of the many factors which influence the behaviour of dyestuffs on textile fibres. The work is being done in close co-operation with the Society of Dyers and Colourists, with whom a joint control committee has been established.

In order to find out the exact influence of light, together with atmospheric conditions, large numbers of patterns have been faded in town, country, and seaside in England, and also in Egypt, India, America, and elsewhere. An examination of the results has yielded considerable information as to the influence of humidity, temperature, and atmospheric impurities on the fading of dyestuffs of widely differing classes on different fabrics. For example, a dyed fabric may fade considerably more rapidly when exposed to sunlight at Leeds than in the dry valley of the Nepa River in California, while a second may show a reverse effect. On examination, it would probably be found that the first dye was very sensitive to humidity, or to sulphur dioxide, or to both, whilst the second was not so sensitive.

The Fugitometer

The Association put on the market some time ago an improved form of fading lamp, known as the Fugitometer, in which the humidity is controlled. This lamp is claimed to be the best instrument available for the purpose at the present time, but it is realised that further research will lead to improvement. It has recently been found that by a proper choice of humidifying solution in the instrument results similar to those obtained at different fading stations at home and in the tropics can be obtained. A few colours, however, still give anomalous results in the Fugitometer, but of these it has been found that many are particularly sensitive to those impurities of the atmosphere which exist in industrial towns. The chief of these impurities is sulphur dioxide, which, under the influence of light or in the presence of moisture, is converted into sulphuric acid, and this is capable of producing considerable change in the shade of many colours. Many such colours can be faded in the Fugitometer to give a sunlight result when a little sulphur dioxide is added, so that by suitable manipulation of the instrument, fading can be quickly carried out in the laboratory which will represent a long exposure in any part of the world.

It is confidently anticipated that continued work along these lines will reveal the reason why the remaining colours do not fade in the Fugitometer exactly as they do in sunlight; further modifications of the instrument to suit these special conditions can then be made.

The work on washing is directed towards the production of a laboratory test which will reproduce the severe treatment given to goods when washed at a laundry. As a preliminary to this, and with the kind assistance of the British Launderers' Research Association, patterns have been laundered on the commercial scale, and these serve as standards to which the laboratory tests are referred. Some of the standards have received a number of consecutive washes, since a dye may appear to be fast when washed a few times and then may break down suddenly after a large number of washes. Other standards have undergone a similar series of washes, but have been exposed to light between each treatment in order to reproduce the conditions under which many articles are used.

As a necessary preliminary to the setting up of a fastness test for perspiration, an important investigation of the composition of perspiration from normal and abnormal bodies is being carried out under the direction of Professor B. A. McSwiney, of the Physiology Department of Leeds University. Prior to this work, very little was known about the chemical character of perspiration, but already valuable data have been collected, and it will very soon be possible to prescribe a laboratory test based on a scientific foundation.

Perhaps the greatest hindrance to progress in colour research is the difficulty of expressing a change of colour by means of numbers. The Department is well equipped with a Guild colorimeter, a Lovibond tintometer, and a complete spectrophotometer, and these instruments are applied each to its particular sphere of usefulness. Results, however, are not easy to interpret, but work is now being carried out on the Guild colorimeter, admitted to be the most accurate instrument available, which should enable any change of colour or brightness or of both to be specified by a single number. Once this is established, the action of light and of other agents on dyed material can be followed with more accuracy than is possible at the present time by any known means.

Sorption of Sulphur Dioxide

In the physical chemistry department study of the gradual absorption of sulphur dioxide by the sorbed alkali in wool has revealed an "active range" within which certain types of dyestuffs on the wool "fade" in quite unexpected fashion, though scheduled as of good fastness to the stoving process, in which excess of sulphur dioxide is employed. The cause has been traced to the formation of "azo-sulphites" of these dyestuffs. The pure chemical research involved in determining this range and the effect of the constitution of the dye on its susceptibility to this action has opened up a wide field of dyestuff research.

This work has established the cause of numerous, erstwhile mysterious, "fading" faults, and has shown that the standard stoving test is inapplicable when dyes of good all-round fastness to sulphur dioxide are required. It has shown also that not only sulphur dioxide from outside sources, but from the constituent sulphur of wool itself, can cause the effect of "fading" when exposed to light, if the dyestuff is susceptible.

Arising out of this work, the chemical department is endeavouring to devise improved bleaching and stripping processes, and new dyestuff applications now being investigated are giving promising results.

Coal-Tar Food Colours

THE United States Department of Agriculture announces that two new colours, Ponceau SX and Sunset Yellow FCF, have been added to the list of coal-tar dyes accepted for certification by the department for use in foods. The following coal-tar dyes are now accepted for certification:—

Red shades:—80. Ponceau 3R. 184. Amaranth. 773. Erythrosine. Ponceau SX.

Orange shade:—150. Orange I.

Yellow shades:—10. Naphthol Yellow S. 640. Tartrazine. 22. Yellow AB. 61. Yellow OB. Sunset Yellow FCF.

Green shades:—666. Guinea Green B. 670. Light Green SF Yellowish. Fast Green FCF.

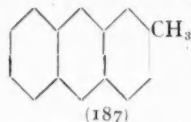
Blue shade:—1180. Indigotine.

The numbers preceding the names refer to the colours as listed in the Colour Index published in 1924 by the Society of Dyers and Colourists of England, which gives the composition of these dyes. Names not preceded by numbers are not listed in the Colour Index.

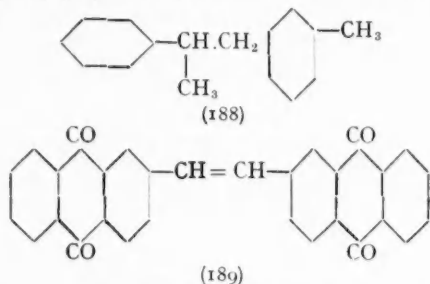
Basic Intermediates for Dyestuffs: No. XXVII.—2-Methylantracene and Its Derivatives

By "Consultant"

2-METHYLANTHRACENE (187) has been obtained by many methods besides the very obvious one of distilling the corresponding anthraquinone derivative with zinc dust. When rosin is distilled with zinc dust, an appreciable amount of



2-methylantracene is found in the distillate, and by similar treatment chrysarobin and emodin (which are hydroxy derivatives of methylantraquinone) can be made to give the same compound. Aniline pitch is another substance which gives 2-methylantracene on distillation in this fashion. The origin of methylantracene in coal tar, in which it occurs to a fair extent, is problematical. It is very probable that its skeleton pre-exists in the lignin fraction of the vegetable matter from which the coal arises; although it has been suggested by some authorities that it arises from the condensation of styrene with *m*-xylene to give the compound α -3-tolyl- β -phenylpropane (188), which has been shown to give a

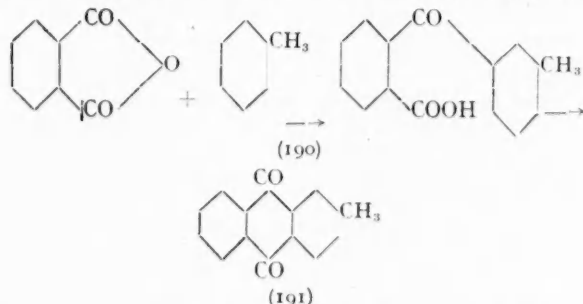


63 per cent. yield of 2-methylantracene on passage through a red-hot tube. 2-Methylantracene is a substance which crystallises in white plates melting at 207° C. It is marked by its curious ability to change into a non-fluorescent bimolecular form on exposure to sunlight.

2-Methylantracene is not used as such, but in the form of the corresponding quinone derivative, 2-methylantraquinone. This compound gives "anthraflavone" on treatment with potassium hydroxide and a reducing agent, and it has been shown that this "anthraflavone" is really *sym*-dianthraquinonylethylene (189). It readily adds on two atoms of bromine, which can be removed with equal readiness by the action of diethylaniline.

2-Methylantraquinone

This substance is not prepared from 2-methylantracene, the economical extraction of which from coal tar is a very difficult matter, but is obtained by the condensation of toluene with phthalic anhydride, to give, in the first place, 2-*m*-toluylbenzoic acid (190) and then by loss of water the required product,



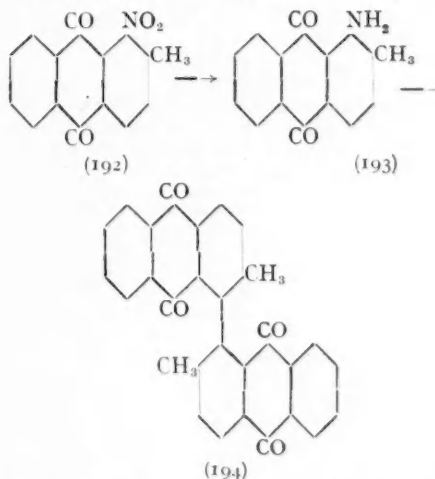
2-methylantraquinone (191). Toluene (4 cwt.) is stirred with very finely powdered phthalic anhydride (1 cwt.) in an

enamelled digester, and anhydrous aluminium chloride is added over a period of ten hours. Two cwt. of the aluminium chloride will be required. After a further stirring period of five hours, water is added (50 galls.) and the excess of toluene is removed by the use of steam. When the distillate no longer shows any signs of toluene, 40 per cent. soda solution is run in until slightly alkaline, the solution heated to boiling with direct steam and filtered hot. On acidification of the warm filtrate with hydrochloric acid the 2-*m*-toluylbenzoic acid separates as a sandy crystalline powder, m.p. 146° C. The yield, which is almost 95 per cent. of the theoretical, is about 160 lb. To convert this substance into 2-methylantraquinone it is finely ground and added to 20 per cent. oleum (about $\frac{1}{2}$ ton) and heated for 90 minutes at 100° C. The reaction mixture is run into water (200 galls.), and the 2-methylantraquinone filtered off at the press. It forms pale yellow needles which melt at 176° C.

Dimethyldianthraquinone

2-Methylantraquinone is valued for the complex condensation products to which it gives rise, many of which are valuable vat dyes. Dimethyldianthraquinone may be made by two alternative processes: firstly, the conversion of the parent anthraquinone into the nitro compound followed by reduction to the aminomethylantraquinone, and the treatment of the diazo compound from this substance with copper powder. The alternative and more satisfactory method is to heat 1-chloro-2-methylantraquinone with copper powder.

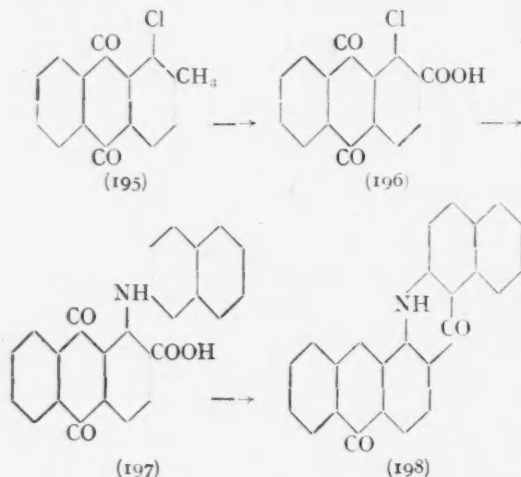
In the former process, 2-methylantraquinone (56 lb.) is dissolved in 98 per cent. sulphuric acid (1 $\frac{1}{2}$ cwt.) and half its weight (28 lb.) of potassium nitrate is slowly added with continuous stirring so that the temperature does not rise unduly. The stirring is continued for twenty-four hours, after which the solution is poured into water (100 galls.) and the crude nitro compound separated by filtration. It is advisable to boil it with crude spirit to remove any unchanged methylantraquinone. The reduction is very simply performed by the use of sodium sulphide. The product from the last operation,



1-nitro-2-methylantraquinone (192) (63 lb.) is heated with crystalline sodium sulphide (220 lb.) and water (63 galls.). The reduction is complete in an hour, and the 1-amino-2-methylantraquinone may be separated in the usual way. To prepare the dimethyldianthraquinone from it, it is dissolved in a large excess of 98 per cent. sulphuric acid (the quantity can be obtained by multiplying the weight of the amino compound by 12.5), and diazotised at the ordinary temperature by the gradual addition of 2/5ths of its weight of sodium nitrite dissolved in concentrated sulphuric acid. The diazo compound, which is comparatively stable, is isolated by pouring on to ice and filtering, as the diazonium sulphate. This

compound is dissolved in seven times its weight of acetic anhydride, and stirred with 20 per cent. of its weight of copper powder. The nitrogen comes off at ordinary temperatures, but the reaction is completed by heating at 100° C. for a short time. The compound is isolated by dilution with water and filtration, the crude product being washed with hot water and dilute nitric acid. It may be recrystallised, although this is not usually necessary, from boiling nitrobenzene.

The alternative process from 1-chloro-2-methylantraquinone (195) is more convenient. The raw material is obtained by operating first for 2-m-toluybenzoic acid in the manner previously described. The condensation to the



methylantraquinone is then carried out in the following way: The benzoic acid derivative (56 lb.) is heated with 5 per cent. oleum (5 cwt.) until the condensation is complete; odine (8 oz.) is then added and dry chlorine is passed in at

50–60° C. until sufficient has been absorbed for the formation of a monochloro derivative. This point is ascertained by pouring a test sample into water and taking the melting point of the dried solid. When the melting point of the sample has fallen to 150° C. the chlorine stream is slackened off; when it has reached 140–145° C. the chlorine is stopped, the product poured on to ice, the solid chloromethylantraquinone being separated by filtration. The chlorination can also be done with sulphuryl chloride in nitrobenzene solution. To get the dimethyldianthraquinone from the chloro body it is heated in nitrobenzene solution with copper powder.

1-Chloro-2-methylantraquinone is also used for the production of dyes of the Indanthrene series. Thus Indanthrene Red RN can be obtained by the following series of operations: 1-chloro-2-methylantraquinone is converted into 1-chloro-anthraquinone-2-carboxylic acid (196) by the action of manganese dioxide and sulphuric acid. The process for the production of the chloromethylantraquinone is operated exactly as indicated above except that instead of isolating the compound a further quantity of sulphuric acid is added (5 cwt.) and sufficient water to bring the content of the sulphuric acid to 80 per cent. (29 gall.). Manganese dioxide (152 lb.) is gradually added, and the temperature maintained at 110° C. until the oxidation is complete (cessation of the evolution of gas). The reaction mixture is poured into water, cleared with sulphur dioxide, and the acid isolated by filtration and cooling. By melting with β-naphthol, it gives the compound (197) which readily yields Indanthrene Red RN (198) by caustic fusion.

Pyranthrones

Dimethyldianthraquinone is used for the formation of Pyranthrone derivatives, as, for example, the so-called Indanthrene Gold, which may be obtained by fusing dimethyldianthraquinone with zinc chloride. The latter (30 times the weight of the intermediate) is fused at 280° C. and the finely powdered dimethyldianthraquinone slowly sifted in. After the last addition of intermediate, the melt is continued for fifteen minutes, cooled, extracted with dilute hydrochloric acid, and the residue of Indanthrene Gold filtered off and washed.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

SOME sections of the dyeing trade, notably piece goods, have been brighter during the past month. Whilst commission yarn dyeing is still unsatisfactory, a number of manufacturers who carry out their own dyeing are busier now than at any time during the past two or three years. Trade as a whole is certainly better, and this has been reflected in the quite brisk demand for dyestuffs of all kinds. At the same time, dyeing prices are in many cases very far from satisfactory. With regard to guaranteed "light fast" cloths dyed in the piece (mainly with vat colours) the prices have been cut very severely, and a similar state of affairs prevails with azoic and vat dyes on coarse yarns for the towel trade.

Interest is still maintained in the question of the price policies of the larger dyestuff manufacturing concerns. It is reported that the German I.G. has been successful in making arrangements with the Swiss and French producers for a regulation of price and probably of production. The I.G. is evidently within measurable distance of a practical monopoly of dyestuff production on the Continent. The question arises: "Has this recent step been taken in view of a possible effort by I.C.I. to enter Continental markets, as well as to extend its trade in India and the East?" If so, it would appear that we may see still lower prices in England, and the importance of the dyestuff legislation which will follow the expiration of the present Act becomes more obvious.

Outside Imperial Chemical Industries, Ltd., two of the largest makers in this country are The Clayton Aniline Co., Ltd., and The British Alizarine Co., Ltd. In well-informed quarters, it is believed that an announcement of a close working arrangement between these latter firms will be made soon, and it is likely to go further than a mere mutual exchange of products.

Scotland

April has been rather a broken month as far as business is concerned, Easter possibly being responsible in part, orders having fallen off in the textile buying houses and the falling off being reflected in manufacturing circles. Industrial conditions remain steady in Scotland, and although there are occasional reports of revival in the engineering and coal industries these probably represent optimism engendered by very local improvements. Thoughts are beginning to turn also towards the election, and this is not likely to help business during the next few weeks.

In the tweed trade, feeling is slightly more optimistic. Although the time is getting past for any further repeats of spring orders, the last few days have been rather satisfactory as regards booking of orders for the winter season. In addition, the 1930 pattern cards are practically ready for sending out, and their reception is awaited with the usual interest. However, stocks are stated to be fairly low at the present time, and it is thought there may, therefore, be some improvement in buying in the near future. The fact that wool prices appear to be fairly stable is also regarded as likely to help. The hosiery section remains much as it was, but those dealing with knitted goods are fairly active.

Dyers and calico printers are having much the same orders as during the last few months, and there is nothing of special note to record.

The botany mills of Sime, Sanderson and Co., Ltd., at Galashiels, are to close down. A proper recovery has never been made from the heavy loss experienced during the slump years following the war. About 150 workers will be affected.

Extensions continue at the works of Scottish Dyes at Grangemouth. The foundations of another new chemical house have been recently laid down.

Dyestuffs Monthly Supplement

Published in the second issue of "The Chemical Age" each month

Communications relating to editorial matter for the Dyestuffs Monthly Supplement should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Advertisement matter, subscriptions, etc., should be sent to the Manager. The Supplement is devoted to the interests of both manufacturers and users of dyestuffs, and contributions will be welcomed.

An Interesting Patent Problem

OUR Lancashire market report in this issue contains a note of more than usual interest on the Patent position as regards the Azoic and Naphthol dyestuffs, which is to a large extent controlled by the I.G. Some speculation is taking place as to whether I.C.I. may possibly decide to challenge the validity of certain Selection Patents. Such a step would be of considerable interest to dye users, because it is felt that the entry of I.C.I. into this field would almost certainly result in lower prices.

The Price Factor

The further reduction of the price factor, adopted by the Licensing Committee in its treatment of applications for import licences, has received less public attention than might have been expected. No official announcement of the change appears to have been made, although it is now definitely known to have taken place. The price factor, which had originally stood at 3 and later at $2\frac{1}{2}$, was reduced to 2 in September, 1927, and it has now been reduced to 1.75. This, of course, means that if a British dyestuff cannot be supplied at a cost of 75 per cent. above the cost of the pre-war foreign equivalent, then a licence to import the foreign equivalent can be granted.

The reduction indicates the desire of the British makers to meet the demand of the consumers for dyes as nearly as possible at the world competitive prices. As a gesture, it will no doubt have a favourable effect. It is another step towards the point at which the British dyestuffs industry is to hold its own in the world market. There is still more than a year and a half before the ten years for which the Dyestuffs Act was passed expires, and the change of Government that is now taking place will cause a certain anxiety, not as regards the period covered by the Act, but in relation to what may happen afterwards. As the Development Committee are now considering a full report on the working of the Act, it may be presumed that any government would desire to take account of their recommendations and that no definite decision will be reached until the report is available.

A New Alizarine Colour

Imperial Chemical Industries, Ltd., announce a new alizarine colour, Alizarine 4B, produced by Scottish Dyes, Ltd. This is a new brand of alizarine and is bluer in tone than any existing market quality. The number of brands of alizarine on the market is very large, but lately the tendency has been to reduce these to some half-dozen of the most popular and well established, which vary in shade from an extreme blue to an extreme yellow. While the tone of the "blue shades" can be easily modified by suitable mixtures with "yellow shades," it has hitherto been impossible to produce bluer tones. The placing on the market of the extraordinarily pure Alizarine 4B now enables the colour user to obtain the much-desired bluer tones.

The pattern card shows the dye itself and the effects produced by mixing with typical yellow shade alizarine, employing the ordinary print and dyes style. There are also illustrations of the customary extract pink and extract red styles, of light and dark purples with an iron mordant and of chocolate shades with a mixed mordant. Some of the latter look very attractive. All the known methods

of applying alizarines are applicable to Alizarine 4B, which is distinguished for its purity. The colour is supplied in the usual form of a 20 per cent. paste.

Solway Colours on Woollen Yarn

We have also received an interesting pattern card showing Scottish Dyes' range of eleven Solway colours on woollen yarn. These colours belong to the acid alizarine series of dyestuffs and are noted for their exceptional brilliance and fastness to light.

Solway Blue B and SE are very valuable for dyeing dress materials, casement cloth, carpet yarn, etc., on account of their excellent fastness to light and good levelling power, which allows of their being salted on at the boil. Both brands leave white cotton effects clean, and the B brand also leaves silk effects untinged. The SE brand is faster to salt, perspiration and alkali than the other. Solway Light Blue R is fast to chrome and therefore gives bright blue shades fast to milling. Solway Cyanine 3FL is similar to the Solway Blues, being excellently level dyeing, but not as fast to light as the latter. White cotton effects are left clear.

Solway Green E, EF, and G may be employed as mordant or acid colours. The fastness to light is excellent and so also, when dyed on chrome mordant or afterchromed, is the fastness to milling, washing, etc. The G brand is the brightest and most suitable for use on loose wool. In addition to these three brands, there are also two special modifications of the G brand not shown, the GD which leaves cotton effects white, and the GS for silk. Solway Purple is exceedingly level dyeing and fast to light, and is largely employed for dyeing dress material and carpet yarn. It cannot be used for shading mordant colours on account of its sensitiveness to chrome.

Solway Blue-Black B and 3B are afterchrome dyestuffs yielding fast grey and black shades on wool. The fastness to light is good, but somewhat less than that of the other Solway colours. Levelling is excellent, and so also are fastness to potting, milling, etc. Solway Grey-Blue RS is a very useful dyestuff for use in dyeing fashion shades for dress materials. The fastness to light is very good, and the feature of the dyestuff is its absolute fastness to salt.

The Solway colours are dyed by the usual process for acid colours, using 2-3 per cent. acetic or sulphuric acid, and 10-20 per cent. Glauber's salt.

Mr. Sutcliffe Smith's Knighthood

Mr. H. Sutcliffe Smith will be generally congratulated on the knighthood that has been conferred upon him in recognition of his public and industrial services. He has been identified with the British colour industry for many years now. There is scarcely any aspect of it that his activities have not touched, and his influence has been steadily used for building up and uniting the whole industry. As the spokesman of the consumers, he has loyally supported the idea, on which the Dyestuffs Act is based, of a national self-supporting industry, and his plea for British dye prices that bear a fair relation to world prices has always taken account of the importance of the British industry itself. The honour conferred on him has been well deserved and will bring him many congratulations.

An American Estimate

In his very interesting and exhaustive review of British chemical trade in 1928 (Government Printing Office, Washington, 10 c.), Mr. Homer S. Fox, American Trade Commissioner, London, devotes a chapter to "Dyestuffs," and discusses especially the price factor and the future of the Dyestuffs Act. As regards the price factor, he writes:—

"There has been some agitation from colour users for a further reduction, both for relief of the colour-consuming industries, and also as an indication that the dye-making industry is making sufficient progress in the reduction of costs to enable it to carry on without further governmental assistance upon the expiration of the Dyestuffs (Import Regulation) Act in January, 1931. This Act, which prohibits imports of synthetic dyes except under licence, was originally intended to be effective for ten years only; in fact, the Act itself specifies that it should be in operation for ten years and no longer; but there is apparently some question as to whether the industry may not seek an extension of official support beyond its expiration, either in the form of a renewal of the Act itself, or in some other form. Colour consumers in general would naturally be opposed to any such extension, for they apparently feel that the manufacturers will have been given sufficient time to place themselves on an equal competitive basis with other dye-manufacturing countries by the end of ten years of restricted imports, and various organisations have already placed themselves on record as being opposed to the continuation of dye-import restrictions in any form."

A Colour Council

The proposal to establish a British Colour Council "for the determination, co-ordination, and propagation of colour tendencies for the fashion and allied trades" will be cordially approved. Hitherto this matter has been left to private initiative, and while good work has been done in giving a lead to colour fashions, everyone will agree that it is better to place this duty in the hands of some representative and responsible body. It is yet another recognition of the importance that the colour factor is attaining in modern life.

In the United States such a Council has been in existence for some time. It will be of interest to see the lines on which the activities of the British Council will develop.

Dyestuffs Production

IN THE CHEMICAL AGE leader columns this week appears a short article on the latest official statistics of British dyestuffs production. It must suffice here to point out that the figures show a substantial all-round increase amounting roughly to 29 per cent. Of particular interest is the increase in vat dyestuffs, showing not only the growing demand for fast colours, but the increasing ability of the home industry to meet the public demand for them.

German Dyestuff Exports

The latest returns respecting Germany's chemical export trade shows that the export trade in dyes, which formerly headed the list, has declined considerably as compared with pre-war figures, and these now take second place after fertilizers among the exports. Before the war the total amount sent abroad was about 110,000 tons, but last year it was only 47,300 tons, as shown below.

EXPORTS OF COAL TAR DYES.
(In metric tons.)

	1926	1927	1928
Aniline dyes	21,168	29,735	30,651
Alizarin dyes	2,502	3,088	2,180
Alizarin red	499	975	2,357
Indigo	12,432	14,301	11,970
Indigo carmine	541	704	153

Home consumption of dyes remains practically constant

at 30,000 tons. Exports are sent mainly to India and the Far East—that is, to China, Japan, and the East Indies; though certain European countries and the United States are still important customers for German dyes.

The I.G. has now arrived at an understanding with the dyestuff producers of Switzerland and France. The exact nature of the understanding is unknown, but it may be that its effect will be visible in the figures for the 1929 exports of German dyes.

Fastness to Chlorine

A method for the production of sulphur dyestuffs, fast to chlorine, is reported to have been patented by Kalle and Co. A.G., Biebrich am Rhein. It consists of melting hydroquinones or their derivatives with nitrocarbazoles, nitrosocarbazoles, nitrosonitrocarbazoles, aminocarbazoles or their derivatives and polysulphides, preferably under pressure. The sulphur dyestuffs thus produced are said to be very fast to chlorine and particularly suitable for cotton. Washing of the colours is effected in the usual manner, advantageously by extraction with amyl alcohol and nitrobenzol.

The Italian Dyestuff Industry

An exhaustive account of the present state of the Italian dye and colour industry is given in a recent number of the *Bolletino di Informazioni Commerciali*. The growth of the Italian industry, it is pointed out, is mainly a post-war development. It has resulted not only in gradual diminution of imports and a growing independence of foreign countries, but also in the growth of an export trade. There are about 15 works in Italy producing dyes, of which about 10 produce sulphur dyes. In 1926, the manufacture of vat dyes was first undertaken, Indigo and Indanthrene Black being among the products. A factory at Cesano Maderno has a daily output-capacity of 6,000 kg. of Indigo, and is therefore in a position to cover the whole of the Italian demand of this dyestuff, which amounts to 600,000 kg. per annum. The production of anthraquinone dyes is still very small.

Dyeing Machinery Taxable

A decision has just been announced by the United States Customs Court, fixing the duty on machinery for dyeing raw cotton. In this decision, written by Chief Justice Fischer, the court found that machinery, the sole function of which is to dye raw cotton, is properly dutiable at 35 per cent. *ad valorem*, under the provision in paragraph 372, Act of 1922, for "all other textile machinery or parts thereof, finished or unfinished, not specially provided for," as classified by the collector. The contention of the importer, Mr. T. S. Southgate, for duty at only 30 per cent. *ad valorem*, under the said paragraph, as a machine and parts thereof not specially provided for, was denied by the court.

Dyestuff Licences for May

The following statement relating to applications for licences under the Dyestuffs (Import Regulation) Act, 1920, made during May, has been furnished to the Board of Trade by the Dyestuffs Advisory Licensing Committee:—

The total number of applications received during the month was 637, of which 612 were from merchants or importers. To these should be added 12 cases outstanding on April 30, making a total for the month of 649. These were dealt with as follows:—Granted, 612 (of which 594 were dealt with within seven days of receipt); referred to British makers of similar products, 29 (of which 20 were dealt with within seven days of receipt); outstanding on May 31, 8. Of the total of 649 applications received, 614 or 95 per cent. were dealt with within seven days of receipt.

German Fastness Commission's Report

Examples of Fastness Tests

In the fourth edition of the report of the German Fastness Commission sections appear dealing with viscose and acetate rayon and setting out in detail the recommended test methods and standards of fastness. The tests given below apply to Dyed Viscose Rayon.

1. Fastness to Light

THE test is carried out by exposing the dyed samples, side by side with the types, each on the same material, under glass in a cabinet placed in open daylight, the dyeings having one-half covered with thick paper or cardboard.

Five types have been established:—

I. Four-tenths per cent. China Green cryst. (495) on mordant. The material is treated for one hour at 60° C. with 1.5 per cent. tannin and 1 per cent. acetic acid, at a bath ratio of 1:20, then left for two hours in the cooling bath, with frequent working, taken out and centrifuged, and after-treated cold for thirty minutes in a fresh bath with 0.75 per cent. of tartar emetic, then rinsed. Dyed as customary for basic dyestuffs.

II. Four per cent. Diamine Rubine S, dyed with 20 per cent. cryst. Glauber salt, 0.5 per cent. soda ash, and 2 per cent. Monopole soap for one hour at 75° C., bath ratio 1:30.

III. Two and one-fourth per cent. Brilliant Benzo Fast Violet BL, dyed as under II.

IV. One and one-half g. Naphthol AS-RL per litre at 30° C., steeped twenty minutes, and after squeezing developed with 2 g. Fast Red RL Base per litre for twenty minutes. For this quantity of Naphthol AS-RL, 2 c.c. of Turkey Red oil, 4.5 c.c. caustic soda solution of 34° B., and 1.5 c.c. formaldehyde are used. (In the developing bath acetic acid is used instead of aluminium sulphate.) After dyeing, soaping with 3 g. Marseilles soap per litre at 60° C.

V. Twenty per cent. Indanthrene Blue GC (843), dyed according to procedure IN, bath ratio 1:30, soaped with 3 g. Marseilles soap per litre of distilled water for ten minutes at 85° C.

2. Fastness to Washing

The test is carried out according to the two following methods:—

(a) The sample is plaited with undyed material as given under 4, and treated at a 1:50 bath ratio for one-half hour, at 46° C., with 2 g. Marseilles soap per litre of distilled water, then squeezed out ten times in handfuls, each handful being each time dipped into the bath, taken out, and squeezed. The sample is finally rinsed and dried.

(b) As under (a), only with 5 g. soap and 3 g. soda ash per litre of bath.

Standards.

I. Treated according to (a): strong alteration of depth and tone, as well as strong bleeding upon the whites.

III. Treated according to (b): no or only slight alteration of the depth and tone; white material coloured.

V. Treated according to (b): depth and shade unaltered; white material unaltered.

Types.

I. One-half per cent. Rhodamine B extra (573) dyed as given under 4, I.

III. Three and one-half per cent. Diamine Fast Violet BBN, dyed as given under 1, II.

V. Ten per cent. Indanthrene Brilliant Green B in paste, dyed as given under 1, V.

3. Fastness to Boiling (Degumming)

(a) The sample, plaited up with silk and cotton, is boiled in a solution of 5 g. Marseilles soap and 0.5 g. soda ash per litre of distilled water for one hour, the water which evaporates being replaced.

(b) As under (a), but boiled three hours.

Standards.

I. Treated according to (a) and (b): depth and tone strongly altered; white material strongly coloured.

III. Depth and tone not or only a little altered; white material, according to (a), somewhat; according to (b) moderately coloured.

Types.

I. Two per cent. Chrysophenine G (304), dyed as given under 1, II.

III. Three per cent. Diazo Rubine B, dyed and developed with beta-naphthol as given under 14, III.

V. Depth and tone unaltered, and white material not coloured, according to methods (a) and (b).

V. Ten per cent. Indanthrene Yellow RK, dyed according to procedure IK; other details as given under 1, V.

4. Fastness to Water

(a) The sample is plaited with cotton, wool and silk, and viscose, in such a manner that there will be about one part of undyed material to two parts of the dyed, and so that each kind of fibre is in immediate contact with the dyed material. The plait is placed in distilled water at about 20° C., bath ratio 1:40, and left for one hour, then squeezed out and dried at ordinary temperature.

(b) Treatment as under (a), only the sample is left in the bath for twelve hours.

Standards.

I. Treated according to (a): strong alteration of depth; strong bleeding upon the whites.

III. Treated according to (b): depth altered little or not at all; white material coloured.

V. Treated according to (b): depth unaltered; white material unaltered.

Types.

I. One-half per cent. Rhodamine B Extra (573), without mordant, dyed for 1 hour at bath ratio of 1:40 with 1 per cent. acetic acid at 50° to 60° C.

III. Three per cent. Chlo-ramine Yellow C (617) dyed according to 1, II.

V. Ten per cent. Indanthrene Brilliant Green in paste, dyed by procedure IN, as given under 1, V.

5. Fastness to Rubbing

The dyed material is rubbed ten times vigorously, back and forth, with a piece of unfinished white cotton cloth (or soft cotton rag) drawn over the index finger. The distance rubbed should be about 10 cm.

Standards.

I. Dyeing rubs off badly.

III. Dyeing rubs off somewhat.

V. Dyeing does not rub off.

Types.

I. One and one-half per cent. Rhodamine B Extra (573), dyed as given under 1, I.

III. Five per cent. Primuline (616), dyed and developed with beta-naphthol as given under 14, III.

V. Two per cent. Cryso-phenine G (304), dyed as given under 1, II.

6. Fastness to Ironing

The dyeings are ironed at about 185° C. The temperature is determined by placing upon the ironing surface of the iron a small crystal of succinic acid (m. p. 185° C.), and waiting until this has completely fused. The drop of melted material is wiped off with a bit of cotton cloth. The dyeings are pressed with the hot iron for ten seconds, but the alteration of the colour on the ironed surface estimated by comparison with the unironed part.

Standards.

I. Dyeing strongly altered; the original tone returns only after some time.

III. Dyeing altered: on cooling, the original tone reappears fairly rapidly.

V. No alteration in the dyeing.

Types.

I. One per cent. Brilliant Benzo Violet B, dyed as given under 1, II.

III. Three per cent. Brilliant Azurine R, dyed as given under 1, II.

V. Three per cent. Diamine Scarlet B (319), dyed as given under 1, II.

7. Fastness to Sulphur Steaming

The sample, plaited with wool and silk, is wetted out in a solution of 5 g. Marseilles soap per litre of distilled water, at 20° C., then wrung out. It is then placed in a chamber filled

with the fumes of burning sulphur, where it remains overnight. It is then well rinsed, squeezed and dried.

Standards.

I. Depth and tone strongly altered; white material coloured.

III. Depth and tone somewhat altered; white material not coloured.

V. Depth and tone unaltered; white material not coloured.

Types.

I. Three per cent. Orange RO, dyed with 15 per cent. cryst. Glauber salt for 1 hour at 50° C. in bath ratio 1:30.

III. One per cent. Diamine Brown 3G (344), dyed as given under I, II, and after-coppered with 1 per cent. copper sulphate and 2 per cent. acetic acid for 20 minutes at 80° C., then rinsed.

V. Ten per cent. Indanthrene Brilliant Green B in paste, dyed as given under I, V.

8. Fastness to Perspiration

The test is carried out as follows: The dyeings are laid between bleached cotton muslin and woollen cloth, and all rolled up together; or they may be plaited with cotton and wool. The sample is placed in a solution of 5 g. common salt and 6 c.c. of 24 per cent. ammonia per litre, bath ratio 1:10, is left in the bath for one-half hour at 45° C., and squeezed by hand ten times at intervals of ten minutes. After one-half hour, 7.5 c.c. of glacial acetic acid per litre of bath are added, and the material treated as before for one-half hour further, squeezing ten times at the end of each ten minutes. The material is then removed, squeezed out well, and dried at the ordinary temperature without rinsing.

Standards.

I. Depth and tone rather strongly altered; strong bleeding upon the white material.

III. Depth and tone not or only slightly altered; white material somewhat coloured.

V. Depth and tone unaltered; white material unaltered.

Types.

I. Four per cent. Brilliant Sky Blue 8G Extra, dyed 1 hour at 85° C. with 40 per cent. cryst. Glauber salt and 2 per cent. acetic acid, then rinsed. Bath ratio 1:25.

III. Three per cent. Diamine Fast Red F (343), dyed as given under I, II, rinsed, and afterchromed one-half hour at 85° C. with 3 per cent. chromium fluoride, and 3 per cent. acetic acid, then rinsed.

V. Twenty per cent. Indanthrene Blue GCD in paste (842), dyed and procedure IN, bath ratio 1:40, as given under I, V.

9. Fastness to Alkali (Street Mud and Dust)

The dyed material is spotted with a solution of 10 g. quicklime and 10 g. ammonia of 24 per cent. per litre, dried without rinsing, and brushed.

Standards.

I. Tone strongly altered.

III. Tone is altered.

V. No alteration of tone.

Types.

I. One and one-half per cent. Malachite Green cryst. (495), dyed as given under I, I.

III. Three-tenths per cent. Direct Deep Black E Extra, dyed as given under I, II.

V. Ten per cent. Indanthrene Brilliant Green B in paste, dyed as given under I, V.

10. Fastness to Cross Dyeing (Acid Boil).

The dyed material is plaited with the same quantity of wool and cotton, and boiled one hour with 10 per cent. sodium bisulphate on the weight of the goods, at a 1:40 bath ratio, then rinsed in cold water, squeezed and dried.

Standards.

I. Depth and tone strongly altered; white material strongly coloured.

Types.

I. One per cent. Rhodamine B Extra (573), dyed as given under I, I.

III. Depth and tone not or little altered; wool rather strongly coloured, cotton not or only slightly coloured.

V. Depth and tone unaltered; white material unchanged.

11a. Fastness to Acid.

The dyed material is spotted with 1:10 tartaric acid solution, and the alteration of colour tone estimated by comparison with a spot made with water.

Standards.

I. Strong alteration of tone.

III. The tone is altered.

V. Tone unaltered.

Types.

I. Two per cent. Benzopurpurine 4B (363), dyed as given under I, II.

III. One and one-half per cent. Direct Deep Black E Extra, dyed as given under I, II.

V. Ten per cent. Indanthrene Brilliant Green B in paste, dyed as given under I, V.

11b. Fastness to Scrooping.

The dyed material is worked for five minutes in a bath of 5 g. lactic acid per litre of distilled water, at a bath ratio of 1:30, at the ordinary temperature, then squeezed out and dried without rinsing.

Standards.

I. Strong alteration of tone.

III. Tone somewhat altered.

V. No alteration of tone.

Types.

I. Three per cent. Benzopurpurine 4B (363), dyed as given under I, II.

III. Three per cent. Benzolive, dyed as given under I, II.

V. Twenty per cent. Indanthrene Blue RS in paste (838), dyed as given under I, V.

12. Fastness to Chlorine.

The test is carried out according to two methods:

(a) The dyed material is plaited with the same amount of cotton and viscose, wetted out, and immersed for one hour in a freshly prepared bath of sodium hypochlorite (1 g. active chlorine per litre) at about 15° C., then rinsed, soured, rinsed, squeezed and dried.

(b) As under (a), only with the use of bleaching powder solution (1 g. active chlorine per litre.)

Standards.

I. Treated according to (a) and (b); strong alteration of depth and tone.

III. Treated according to (a); no or only slight alteration of depth and tone. Treated according to (b); strong alteration in depth and tone.

V. Treated according to (a) and (b); depth and tone unaltered.

Types.

I. One and one-half per cent. Diamine Brown M (344), dyed as given under I, II.

III. Five per cent. Hydron Blue R 30 per cent. paste (748), dyed according to the hydrosulphite method.

V. Padded with 2 g. Naphthol AS-BO per litre at 30° C. Steeped for 20 minutes, and after squeezing developed with a 2.7 g. Fast Red B Base per litre for 20 minutes. (For 2 g. AS-BO, use 3 c.c. Turkey Red oil, 6 c.c. caustic soda solution of 34° B., and 2 c.c. of formaldehyde. Use acetic acid in the developing bath in place of aluminium sulphate.) After dyeing, soaped with 3 g. Marseilles soap per litre at 60° C.

13. Fastness to Bleaching.

The dyed material is plaited with wool, cotton and silk, and bleached with hydrogen peroxide. The bleaching bath is made up with 100 parts of distilled water, and twenty parts of hydrogen peroxide of 10 to 12 per cent. by volume. The solution is made very weakly alkaline with a small quantity of water glass solution. The bath must be kept alkaline during the process of bleaching (test with red litmus paper.)

The material is placed in the bath at about 45° to 50° C. (bath ratio 1 : 40 to 1 : 50) and allowed to lie for twelve hours in the slowly cooling bath. Care must be taken to keep the material always under the surface, and strong stirring must be avoided. After bleaching, the material is rinsed and dried.

Standards.

I. Depth and tone strongly altered; white material coloured.

III. Depth and tone not or little altered; white material coloured, but less so than under I.

V. Depth of tone unchanged; white material uncoloured.

Types.

I. One per cent. Rhodamine B Extra (573), dyed as given under I, I.

III. Three per cent. Benzo Red 10B, dyed as given under I, II.

V. Ten per cent. Indanthrene Brilliant Green B in paste, dyed as given under I, V.

14. Fastness to Milling.

The test is carried out by the use of two methods :

(a) Neutral Milling: The dyed material is plaited with the same quantity of wool and cotton, then treated at 30° C. in a milling bath (ratio 1 : 40) of 20 g. Marseilles soap per litre of distilled water. The sample is first well milled by hand, then left in the bath two hours, then milled well again, washed and dried.

(b) Alkaline Milling: Treatment is as above, but at a temperature of 40° C.; the bath containing 20 g. of Marseilles soap and 5 g. of soda ash per litre.

Standards.

I. Treated according to (a); strong alteration of depth and tone; white material coloured.

Types.

I. One per cent. Rhodamine B Extra (573), dyed upon pre-mordant as given under I, I.

III. Treated according to (a); no or only slight alteration of depth and tone. White material not coloured, or only the cotton coloured.

V. Treated according to (b); depth and tone unchanged; white material uncoloured.

15. Fastness to Potting.

The dyed material is plaited with the same amount of wool and cotton, and placed for two hours in seventy times the quantity of distilled water at 90° C., then rinsed and dried.

Standards.

I. Depth and tone strongly altered; white material strongly coloured.

III. Depth and tone not or hardly altered; white material coloured, but not so strongly as under I.

V. Depth and tone unchanged; white material uncoloured.

Types.

I. Two per cent. Chrysophenine G (304), dyed as given under I, II.

III. Three per cent. Primuline (616), dyed, diazotized, and developed with beta-naphthol as given under I, III.

V. Ten per cent. Indanthrene Brilliant Green B Paste, dyed as given under I, V.

16. Fastness to Dry Steaming (Decatizing).

(a) The dyed material, wrapped up in woollen cloth, is steamed in the steamer for ten minutes at a pressure of one-half atmosphere.

(b) As above, but steamed for ten minutes at a pressure of 2½ atmospheres.

Standards.

I. Treated according to (a); depth and tone strongly altered.

V. Treated according to (b); depth and tone unchanged.

Types.

I. Three per cent. Sulphocyanine G (257), dyed as given under I, I.

V. Twenty per cent. Indanthrene Blue GC, dyed as given under I, V.

(To be concluded.)

Dyes and Their Application: Recent Technical Progress

By L. J. Hooley

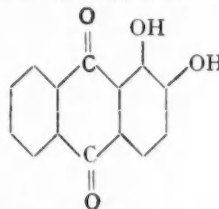
IN 1823, Kuhlmann, founder of the Etablissements Kuhlmann, reported that he had isolated the colouring matter of madder. However, perhaps due to insufficient description, his results could not be duplicated by other chemists, and the first undisputed isolation of the substance was that of Robiquet and Colin in 1826, who gave the name alizarine to the new product. Complete publication of their results was made in 1827, so that 1927 may be regarded as the centenary of the discovery of alizarine. A centenary lecture given by Wahl before the Chemical and Chemical Industry Societies of France will be found in the *Bulletin Soc. Chim. France* (1927, 41, 1417).

The Importance of Alizarine

On account of its antiquity, its complicated method of application, many-sided applicability, fastness and world-wide importance, as well as its influence on the development of the dyestuff industry, alizarine has no rival but indigo. The twenty-six pages of Wahl's account include the most important and significant features, as well as forming a very interesting sidelight on the development of the dye industry.

A few of the more outstanding points may be mentioned before going on to discuss more recent developments. To begin with, alizarine does not occur as such in madder, but is extracted from the root in the form of a glucoside; and even this glucoside does not represent the initial colouring matter formed in the plant. However, since alizarine has been made from anthracene, the composition of madder has lost its practical interest.

When alizarine was discovered, anthracene was unknown, and it was not until considerably later that Graebe and Liebermann determined its constitution:—



Other formulæ have been suggested for alizarine, in addition to the para-quinone one shown above, in which the hydroxyl and quinone group are partly interchanged, and it cannot be said that the matter has been definitely settled; but for ordinary purposes it is not important.

Use with Mordants

Alizarine itself has practically no affinity for textile materials, and is only used on mordants. The most interesting feature of this mordant dyeing is the way in which alizarine stands out from the other hydroxy anthraquinones. Of the two mono- and the ten di-hydroxy derivatives, alizarine is the only one of importance as a mordant dyestuff, and of the tri- and higher hydroxy derivatives, those which are of interest always have two at least of their hydroxy groups in the positions corresponding to those in alizarine.

The composition of the lakes formed with the mordants is, like that of the natural madder, complex and largely undetermined. The shade varies with the mordant chosen; thus aluminium gives a red, chromium a brown and iron a purple shade. By mixing mordants and secondary constituents, a great variety of shades can be obtained, and this possibility has enormously increased the importance of alizarine, as well as in the past providing a large number of fast shades when other facilities for doing this were small. It is important to remember that 60 or 70 years ago the consumption of madder was as high as 150,000,000 lb. per annum, which, considering the smaller scale of business at that time, was an impressive figure.

Synthesis of Alizarine

The first synthesis of alizarine was that of Graebe and Liebermann from dibromoanthraquinone (1865), although they were to a certain extent fortunate in obtaining it this way. Perhaps the element of luck in their synthesis is not quite so large as has been imagined, since alizarine can be obtained by several other reactions where it would not be expected. However, this is not the only interesting episode in the alizarine story.

Another one is that of Caro, who, being accidentally called away from his laboratory while treating anthraquinone with sulphuric and oxalic acids, with the idea of preparing a rosolic acid derivative, allowed the product to go dry. On returning, he noticed a pink coloration at the edge, which he was quick enough to recognise as the aluminium lake of alizarine, the aluminium having come from the vessel. The resulting sulphonation method was patented on June 25th, 1896, while Perkin, remarkably enough, patented the same process one day later. This method of making alizarine, by sulphonating anthraquinone and then fusing with alkali, was a comparatively simple one, and it was able in the course of a few years practically to make an end of madder cultivation. At the same time, it made large profits for its possessors and exerted a very important effect in the development of the dye industry.

The method has remained the standard one for the production of alizarine, though recently the alternative synthetic method from phthalic anhydride has been developed by Scottish Dyes, Ltd., e.g., E.P. 174,101 (A. H. Davies); 246,529 (H. A. E. Drescher and J. Thomas); 248,411 (J. Thomas).

Application

The dyeing of alizarine is a specialised branch demanding considerable experience. The process is very complicated, although not now so involved as it used to be, when the operation required more than three weeks to carry through. The difficulties are increased by the fact that fastness and brightness, both of which are of so much importance, are not entirely the natural properties of the lake, but also depend on the conditions under which the lake is actually formed and deposited on the fibre. Going through the process very briefly, the production of the well-known red shades on cotton involves first of all an efficient boiling out of the material, then impregnating it with Turkey Red oil, printing the oiled material with basic aluminium sulphate, fixing the mordant in a bath of chalk, dyeing, and finally steaming. Each of the stages thus briefly mentioned requires its own special technique.

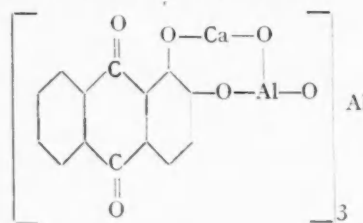
Recently, E. P. Victoroff has published an interesting paper dealing with some aspects of mordanting, especially the influence of the anions of the mordant on the shade of alizarine red lakes (*J.S.D.C.*, 1928, 336, and also *Revue Générale*, 1928, 253). The slightest trace of iron is liable to spoil the brilliance of alizarine reds obtained, and it is particularly important to avoid this; in fact, the two most important factors in the process are (a) the rate of lake formation on the fibre during the steaming process; and (b) the avoidance of the formation of the iron lake. Now iron is practically always present in one or other of the products used in the dyeing, but the addition of certain substances to the mordant can prevent its spoiling the shade. It appears that the iron lake of alizarine is a ferric lake and not a ferrous one, and apparently addition of a substance which keeps the iron in the ferrous form is likely to prevent formation of the iron lake.

Victoroff has tested the influence of reducing and oxydising agents, using printing pastes containing very substantial quantities of iron. Among the reducing agents, hydroxylamine

was found to give particularly valuable results. Sodium hydrosulphite, formic acid, glucose and lactic acid were also of value, although not quite so effective; potassium chlorate gave the worst results. The question is a complicated one, and the effect of other interactions between all the substances present in the mordant have to be allowed for. Of interest is the effect of sulphocyanides; the author shows that the value of these lies in their preventing absorption of iron. They do not prevent the action of iron if this is already present in the printing paste.

Constitution of the Red Lake

As regards the actual structure of the lake of alizarine red, various formulæ have been proposed, none of which are entirely satisfactory. It is fairly clear that no simple formula has been given which is capable of representing adequately the composition of the lake, and equally certain that the lake is not of constant composition. It almost certainly contains aluminium and calcium, and the oil possibly enters in as well. Attached is shown Prudhomme's formula:—



The question of whether the formation of the lake is due to chemical action or adsorption has received a considerable amount of attention. It seems fairly clear that both may take place, and in any case whether adsorption is chemical change is partly a matter of definition.

Another recent paper on this constitution question is by Leipatov (*Textilber*, 1928, 496) who investigates the results obtained with barium and copper in the case of nitroalizarine by examining the compounds formed with barium and copper acetates. He separates them into barium and copper alizarates contaminated with free nitroalizarine derivatives.

Weiser and Porter (*J. Phys. Chem.*, 1928, 1834), in examining the mechanism of the formation of lakes of alizarine with the hydroxides of iron, calcium and aluminium, come to the conclusion that the formation of lakes is due to the adsorption of the anion of the colour. The influence of the concentration of the hydrogen ion on the adsorption of Alizarine SW is comparable to that of sulphate or oxalates.

Among recent recommended methods in connection with the application of alizarine the following may be mentioned:—Alterhoff (*Liepsig Monats. Text.-Ind.*, 40, 216) describes an important method for obtaining reds on natural silk which avoids any harshness of feeling and gives very fast dyeing. Complete details are given for preparing the mordant and for avoiding iron. According to a sealed note by O. Scheurer, the saddening of alizarine prints by contamination with metallic compounds during printing is avoided by the addition of a gelatinous solution of aluminium hydroxide to the printing paste (*Bull. Soc. Ind. Mul.*, 1929, 123).

Inquiry into Forest Research

In order to define the lines of future activity and advance of the Forest Research Institute of Dehra Dun, which is now nearing completion, the Government of India have appointed a small committee. The terms of reference are as follows:—

- (1) The organisation, working and control of the Forest Research Institute at Dehra Dun with special reference to the scientific and economic value of the work already done and the desirability or otherwise of periodical scrutiny in future;
- (2) The need for assuring co-ordination with a view to the achievement of scientific accuracy and better interchange of knowledge between the inquiries in progress at the Institute and similar investigations abroad, especially in America and Europe, and ensuring suitable publicity of such results as are capable of utilisation for industrial purposes;
- (3) The system of recruiting members of the staff, especially technical experts;
- and (4) The system of training Indians in scientific research. The Committee has already started work.

The Emission of Fumes from Artificial Silk Works

Report by the Chief Inspector of Alkali Works

The Ministry of Health has just issued a "Report on an Investigation Regarding the Emission of Fumes from Artificial Silk Works," by the Chief Inspector of Alkali Works. The report, which is reproduced below, is published by H.M. Stationery Office (pp. 7, 3d.).

THE Chief Inspector of Alkali Works (Dr. T. Lewis Bailey) states in the report that, in accordance with directions which he received in April last year, he has conducted special investigations into the emission of fumes from artificial silk factories.

The production of artificial silk in Great Britain in 1922 was about 7,000 tons; by 1927 it had risen to 17,000 tons, and the production in the first half of 1928 was stated to show an increase of fully 50 per cent. on that for the corresponding period of 1927. There are several different processes for making artificial silk from cotton or from wood pulp, viz.:—the viscose process, the acetate process, the cuprammonium process, and the nitro-cellulose process. The first method only calls for consideration in this report.

Odours and Gases from Viscose Works

The viscose process is responsible for something like 80 per cent. of the total production, and it is this process which has given rise to complaints of unpleasant smells outside the works and of prejudicial conditions for workers in the factories themselves. The various works have been inspected very carefully on a number of occasions without notice being given, and facilities have been readily granted in every instance for obtaining information as to the methods of conducting the process. Special attention has been paid to the gases emitted from the works.

The sources of possible trouble, in so far as unpleasant smells in the surroundings of the works are concerned, are the air that has been drawn through the factories for the purpose of ventilation, and the liquid effluent from the works.

There is in the air from these works a certain amount of sulphuretted hydrogen; it amounts to only a few parts per million (by volume) at the point of its emission from the works, but it must be remembered that the characteristic odour of sulphuretted hydrogen can be detected when this gas is present to the extent of only one part in a million of air.

The odour in the neighbourhood of the works, however, is not quite that of sulphuretted hydrogen—it appears to be somewhat modified by the presence of very small quantities of other compounds whose identity cannot be definitely established. Certain sulphur compounds are known which have a discernible odour when present to the extent of merely a small fraction of one part in a million of air. No evidence is forthcoming that the air from these works constitutes a danger to the health of the community, but it is capable of being distinctly unpleasant.

Attempts to Obviate the Odour

Many attempts have been made to deal with the gases in such a way as to remove the smell, but, so far, no satisfactory method has been evolved. Manufacturers are fully alive to the possibility of trouble, and much time and money have been spent on attempts to remove the objectionable constituents. The earliest experiments to be made in this direction consisted of endeavours to wash out these constituents by passing the air from the works through very large towers supplied with a run of caustic soda solution. A certain proportion of the sulphur compounds can be removed by such means, but the complex nature of the gases has been a stumbling block, and, as a consequence, the gases emitted from the towers still possess the characteristic odour which it is desired to get rid of. Other methods of using caustic soda solution as a deodorising agent have also been tried, but still with unsatisfactory results.

The effect of other absorbents has been investigated, but up to the present the hoped for results have not been attained. The action of gaseous reagents such as chlorine and sulphur dioxide has been tried, in the hope that it would prove possible in this way to decompose the sulphur compounds contained in the gases. The possibility of obviating the evolution of unpleasant gases by adding suitable materials at particular stages in the course of the manufacture has not been lost sight of, and in this direction improvement of atmospheric

conditions may be said to have been to some extent brought about, but satisfactory removal of the odour has not yet been obtained.

Suggested Lines of Investigation

New processes of manufacture naturally bring with them new difficulties, and this is peculiarly so in the case of the viscose method of making artificial silk. The chemical reactions involved at the various steps of the manufacture are of a very obscure nature, and this in itself increases the difficulty of prescribing a remedy for the existing troubles. More work is still needed on the use of absorbents, on electrical methods of treating the gases and on the reactions that actually take place in the course of the manufacture. With all such work we shall keep in close touch, and we shall render whatever aid we can.

A great deal of experimental work has been done in the United States of America on the efficacy of caustic soda, hypochlorite solutions and other reagents, when used for treating the gases, but so far none of these has provided a remedy. It can be said also that the works in England compare favourably with those in Germany—in fact the waste gas problem is receiving more attention in England than it is in Germany.

Nature of the Viscose Process

The essential steps in the manufacture of artificial silk by the viscose process are as follows:—(1) Wood pulp is treated with caustic soda, and so transformed into alkali-cellulose, which is hydraulically pressed and then disintegrated into the form of "crumbs"; (2) the alkali-cellulose is treated in closed revolving churns with a carefully regulated amount of carbon bisulphide, the churns being ventilated on the conclusion of the reaction; (3) the next stage consists in dissolving the material obtained in the last operation, with production of a liquid of syrupy consistency, which is the viscose from which the thread is produced; (4) after this syrup has been kept in closed vessels for a specified period it is forced in very fine streams into a liquid bath, where decomposition of the viscose takes place with production of artificial silk threads, which are spun together. The product is finally chemically washed, in readiness for further mechanical treatment.

Origin of the Odour

The stages at which there is possibility of evolution of offensive gases are (2) and (4), the latter being the main source of trouble. In stage (2) small amounts of carbon bisulphide are emitted during the clearing of the churns. In stage (4) the decomposition of the viscose during production of the artificial silk thread is accompanied by production of sulphuretted hydrogen, as well as of, no doubt, other sulphur compounds which have not been definitely identified. This result is brought about by the composition of the spinning bath, which usually contains essentially sulphuric acid, but there are also certain other constituents, such as sulphate of soda and other inorganic salts.

The sulphuretted hydrogen and other gaseous compounds, produced by the decomposition of the viscose in the spinning bath, dissolve to some extent in the liquid contents of the bath, the remainder being given off. Sulphuretted hydrogen is more readily soluble in glucose solution than in water, and it is common practice to use glucose in the spinning bath.

Nevertheless, there is still evolution of sulphuretted hydrogen from the bath, and in order to remove this from the atmosphere of the workrooms extraction as near the point of production as possible and thorough ventilation by means of fan draught are resorted to. Complete boxing-in of machines, with separate treatment of the gases at the points of evolution at the numerous spindles, is impracticable.

Ventilation

The Factory Department of the Home Office insist on efficient draughting by fans, and the result is that change of air is of the order of at least 13 times per hour, the volume in the case of the larger works amounting to something like

half a million cubic feet per minute. The enormous volume of air from the workrooms is taken through large flues to a chimney, and it is not uncommon to build these chimneys to a height of 350 feet, with a view to increasing as far as possible the diffusion of the gases before they can reach ground level.

It will be appreciated that to treat volumes of air of the amount and velocity indicated above, in order to remove all possible source of trouble, is a problem not easy of solution, especially in the case of the larger works, and one turns naturally to the question of the possibility of prevention, that is to say, fixation of the gases so that they may not be evolved from the process. The great difficulty here is to find a means of fixing the gases without at the same time spoiling the thread. Could some such method as this be devised, the offensive compounds would be contained in the liquid effluent from the works, instead of in the air, and in this form it is possible that they could be more easily dealt with.

Effluents from Viscose Works

Nevertheless, it is true that the liquid effluent, produced at the present time, has in places given rise to trouble, atmospheric pollution arising from it. This has been ameliorated by improved details of effluent treatment. The inevitable result of running liquid containing free acid into liquid that contains sulphides is in immediate evolution of sulphuretted hydrogen. Both types of liquid are produced as effluents from a viscose artificial silk works. Neutralisation of free acid should be effected with certainty before such effluents are allowed to mix with each other.

It has been necessary to call attention in several instances to this need for neutralisation of free acid in dealing with the works effluents. If this is not done, serious atmospheric pollution by sulphuretted hydrogen and other disagreeable compounds is bound to occur. Moreover, precipitation of sulphides from solution and efficient separation of solids should be effected before the effluent leaves the works. There seems to be no doubt that a great deal of the trouble experienced from some works has been due to faulty treatment of effluent. By getting attention paid to details of effluent treatment it has been possible to reduce considerably the causes for complaint in some quarters.

To sum up, inspection of viscose works has shown that, speaking generally, there is an emission of sulphur compounds from the works, but the actual amount, though it may be objectionable, is not high. There is no evidence that the health of the community has suffered from the existence of these works, although the amenities of everyday life may have been in certain places interfered with. Conditions both outside and inside the works are receiving, and will continue to receive, attention, with a view to discovering a solution of these difficulties. The conditions inside the works have received close attention from the Factory Department of the Home Office, and much has been effected in the interests of all in any way connected with the works.

Health Hazards

Writing in the 1927 Report of the Chief Inspector of Factories and Workshops (pp. 104-106) on the manufacture of, artificial silk, Dr. J. C. Bridge, Senior Medical Inspector, states that the health hazard in this manufacture is chiefly centred in two operations, churning and spinning. The risk to health in the churning process is from the fumes of carbon bisulphide: the manufacture, with the exception of one large firm, has not been in operation in this country for any great length of time, so that the effects of exposure to carbon bisulphide over long periods cannot be definitely ruled out, although he considers that the arrangements in use limit the possibility of cases of this nature arising.

The hazards in spinning are injury to the fingers, and conjunctivitis. Various methods have been found to obviate injury to the skin of the hands. In the case of conjunctivitis the condition usually passes off in 24 hours, but it may last from one to three days. Inquiries indicate that there is no evidence of permanent injury. The conjunctivitis has been attributed to sulphuretted hydrogen gas, but it may be due to acid spray or to rubbing the eye with fingers contaminated with the acid solution. Prompt treatment has been effective in mitigating the condition and in reducing the number of cases requiring absence from work. Whether sulphuretted hydrogen or acid spray be the cause, effective ventilation is called for.

Dyestuffs Markets: The Month's Business in Review

From Our Own Correspondents

Lancashire

It is believed that an attempt will shortly be made to upset the present position regarding dyestuffs of the Azoic or Naphthol AS class. The original patents, taken out as long ago as 1912, have now expired, but certain Selection Patents taken out by the I.G. are still in operation, and since these cover many combinations of exceptional fastness to boiling alkalis, the I.G. retain a virtual monopoly, subject to an arrangement with British Synthetics (now taken over by the British Alizarine Co.), who are manufacturing certain naphthols under licence, and who merchant all the I.G. naphthol products.

So far as the bases are concerned, these are made by several British manufacturers, and recently the Clayton Aniline Co. have extended their range by including the TR and RL Bases, whilst Messrs. Leitch are manufacturing a wide range suitable for application not only to cotton but also to silk and wool. For some years, however, there has been a tendency on the part of dyers to utilise the so-called "salts" or stabilised form of the diazotised bases. It would seem that the principal patents for these substances are also held by the I.G., since the manufacture of these salts by a British firm has been relinquished.

For a long time the most important member of the series, Naphthol AS itself is now giving way to other naphthols, such as the Naphthol AS-TR (of greater fastness to washing, and especially to alkalis), and (where fastness to light is concerned) to such newer members of the series as the Naphthol AS-RL. It is, therefore, evident that the expiration of the original patents will have no very serious consequence to the I.G., if the later patents, which protect the application of combinations of greater value than those from the original Naphthol AS, can be maintained.

It is believed that I.C.I. contemplate challenging the validity of these Selection Patents—perhaps on the ground that a patent covering a large number of applications might be kept in existence in perpetuity by appropriate selections.

Such a case, apart from the very important principle involved, would be of considerable interest to dye users, because the entry of I.C.I. into this field will almost certainly result in considerable reductions in price.

Scotland

As far as business is concerned there is not a great deal to report for May. Trade has been somewhat variable, but on the whole has kept at about the same level as last month. In the Glasgow and Paisley districts dyers and printers have been fairly well occupied.

In the woollen trade the falling off which has been noticed during the last few months has not shown any signs of improvement recently. With regard to the recent patterns, orders have not been too satisfactory and only makers showing considerable variety and novelty have booked anything like sufficient so far, although, of course, more may be expected to come along later.

The election appears to have caused little or no disturbance. The woollen industry is to be commiserated with on having its expectations of Safeguarding aroused only to see the chance of their fulfilment in the near future disappear again. Others interested in Safeguarding or similar matters will also regard the future with some uncertainty, and it will be remembered that the Dyestuffs Act has not a long time to run now.

With Sir Edward Brotherton and Mr. H. Sutcliffe Smith in the Birthday Honours list, both the manufacturing and consuming sides of the colour industry are represented.

Memorandum Section

For the use of the Department of the Interior

OF THE

DEPARTMENT OF THE INTERIOR

WASHINGTON, D. C.

CHIEF OF BUREAU

MEMORANDUM FOR THE

CHIEF OF BUREAU

MEMORANDUM FOR THE

CHIEF OF BUREAU

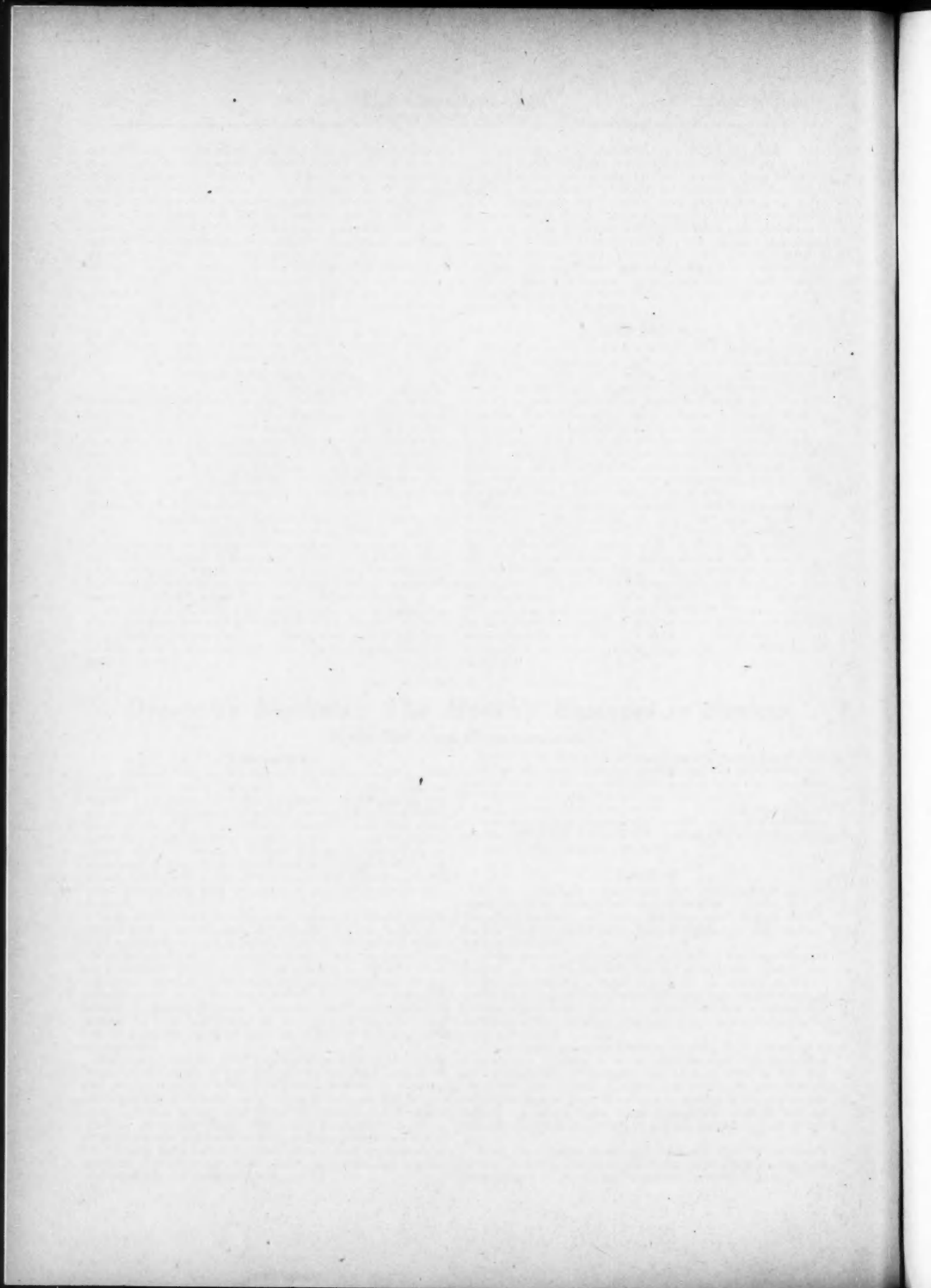
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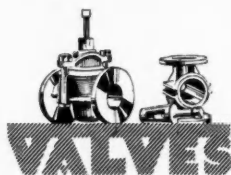


Metallurgical Section

Published in the first issue of "The Chemical Age" each month

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FIRTH STAYBRITE STEEL for CHEMICAL PLANT

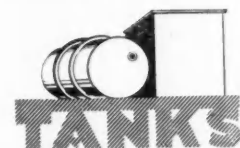


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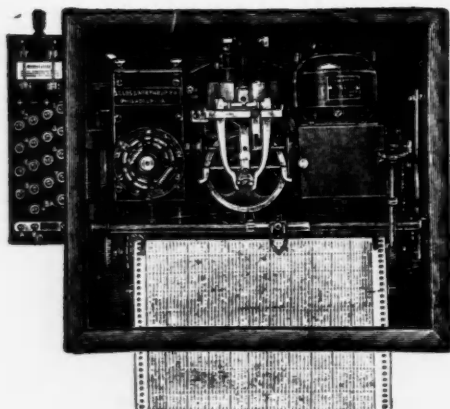
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Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our *Monthly Metallurgical Section* should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Wet Extraction of Cobalt from Poor Ores

(From a Correspondent)

RICH cobalt ores are only scantily distributed through the earth's crust, but poor ores, or ores of other metals containing a small proportion of cobalt, occur much more frequently. In the latter instance, the bulk of the foreign metals present offer a serious obstacle to the economic recovery of cobalt, and there are many of these ores which are not worked at the present time for this reason.

As the recovery entails a number of varied separations, the plant employed is considerable, and hence it is necessary to work on a comparatively large scale to make the extraction a paying proposition.

First Stage of Extraction

The first stage in the process consists of grinding the ore to a fine powder and mixing it with a fixed proportion of rock salt. Sulphur ores containing cobalt require a preliminary roasting treatment prior to the grinding. The mixture of ore and salt is charged into a specially constructed roasting furnace and roasted until all the cobalt has been converted to the soluble chloride.

This furnace is fired by producer gas, and the mass on the hearth raked up continuously by revolving arms which are worked by power. The hot mass is discharged into lixiviating tanks from skips and treated with a mixture of dilute hydrochloric and sulphuric acids. (In dealing with residues containing only a small percentage of sulphur it is usual to add some to the furnace charge in the form of pure iron pyrites.)

Chemical Reactions Involved

One German metallurgist who worked out a process for treating poor cobalt ores went very thoroughly into the reactions which occur here. These need not be dealt with in detail, and only the more important ones need be mentioned: Cobalt oxide partly dissolves in the hydrochloric acid forming cobalt chloride. The chlorine of the rock salt also partly combines with the cobalt forming the chloride; the sodium set free combines with the sulphur gases evolved, forming ultimately sodium sulphate. Nickel is acted on in the same manner as cobalt, as also is copper. Iron is not readily attacked, and remains almost entirely in the residue. Nearly all the calcium present is precipitated as sulphate. After the action has been completed, the liquor is syphoned into another tank, and the residues well washed with slightly acid water and then with hot water.

Separation of Copper

The separation of copper and any lead remaining in solution is effected by the addition of sulphuretted hydrogen. A small earthenware pot which has numerous perforations is filled with small pieces of sodium sulphide (crudely prepared from pyrites) and then lowered into the tank. The liquor is kept agitated with plungers so that it all comes in contact with the pot. The acid in the liquor attacks the sodium sulphide, which evolves sulphuretted hydrogen, precipitating copper and lead, and not affecting nickel, iron or cobalt in the presence of free acid.

Samples of the liquor are tested, and the pot removed when all the copper and lead have been precipitated. The clear liquor is syphoned off, and the black precipitate washed with acidified water, dried on a small kiln, bagged, and smelted together with other copper material containing lead.

Separation of Iron

The filtrate from the copper is neutralised by adding soda ash, and then a large excess of crude sodium sulphide is added. In place of soda ash, lime water is sometimes used, which is

much cheaper and quite as effective, the only objection to it being that if much sulphuric acid is present calcium sulphate will be precipitated, which will be mixed with the sulphides of cobalt and nickel.

The black precipitate formed is principally composed of sulphides of cobalt, iron and nickel, but also contains some of these metals as hydroxides, which leads to a slight loss of cobalt when treated with acid. After settling, the liquor (which should be clear and colourless) is syphoned off.

When these filtrates contain much sulphide they may be used to precipitate the copper in the succeeding charges. The precipitate is now treated with weak hydrochloric acid and the mass continuously stirred up with wooden plungers. The acid attacks and dissolves the iron sulphide but does not affect the cobalt or nickel sulphides. Gases evolved here are mainly composed of sulphuretted hydrogen, and require to be removed by a vent, fitted above the tank, which has a strong draught and leads them to the main flue. If the action is allowed to continue too long nickel and cobalt sulphides might be partly dissolved.

Rapid tests of the percentage of iron remaining in the precipitate are made, and when this has been reduced to a certain figure, the acid is removed. The black precipitate is washed several times, first with acidified water and then with hot water, until only traces of iron remain.

Separation of Nickel

The wet precipitate of nickel and cobalt sulphides is carefully dried and then roasted in a small kiln. This roasting process requires to be very carefully conducted, so as to convert the sulphides into sulphates. The mass is raked back and forwards with large rabbles so as to expose fresh surfaces to the action of the air. After the odour of sulphur gases has disappeared from the mouth of the kiln, a sample is removed and tested to find the amount of sulphates formed.

When the mass is nearly all converted to sulphates the roasting is stopped, and the precipitate removed from the kiln. It is then charged into a small vat containing dilute sulphuric acid, which is heated by means of a steam jet. If the roasting has been properly conducted the mass will dissolve almost completely.

A large variety of methods have been suggested for separating nickel from cobalt, but nearly all of them entail the use of expensive reagents, which would scarcely be economical when dealing with poor ores. The following method is inexpensive, and though it requires more time, is quite as effective as the others: If the solution is too strongly acid, the excess is neutralised by addition of ammonium hydrate (which is reclaimed at a later stage). Ammonium bisulphate is now added and the solution carefully evaporated. When it has been sufficiently concentrated, a double salt of nickel separates out as a difficultly soluble mass containing a little cobalt, while the large bulk of the cobalt remains in solution. (This precipitation sometimes requires to be repeated to make a perfect separation.) The solution is filtered without washing, and the nickel precipitate reserved for further treatment.

Recovery of Cobalt

Sulphuretted hydrogen gas is passed into the liquid, which precipitates cobalt as sulphide. The gas addition is a much more desirable method than adding sulphide salts, which would require to be washed out of the precipitate. After settling, the solution is filtered and washed with slightly acid water. The mass is then dried and roasted to freedom from

sulphur on a small kiln, the temperature here used being much higher than that used in converting nickel and cobalt sulphides to sulphates. This roasting converts the cobalt sulphide to sesquioxide, in which state it is packed in barrels and sent to market.

The work of converting sulphides to oxides or sulphates can only be successfully accomplished by having the material rapidly analysed or tested at each stage of the roasting. As

a general rule, the operations are conducted by furnacemen skilled in this class of work, so that as little testing as possible need be done. The sesquioxide is the most important salt of cobalt, and it is the starting point in the preparation of its various compounds and of the pure metal.

Up to the present time, no dry methods have been used for extracting cobalt. Processes have been suggested, but nothing is yet known of their economic value.

The Tempering of Steel

A Discussion of the Homo Method

AFTER tools or parts have been hardened correctly, maximum working life rests upon precision in tempering, and low production costs demand certainty and facility in the process. The proper steel structure for maximum working life depends upon the critical determination of temperature and then upon the accurate, uniform application of heat in the tempering operation.

In considering what method to adopt, the following points require thought: The medium for transmitting heat to the

heating medium, is excellent if it can be designed to meet the remaining conditions.

Methods of Heating

As the heat transmitted by radiation increases as the fourth power of the increase in temperature, radiation is comparatively efficient at high temperatures and less efficient at low (tempering) temperatures. While this difference may be negligible when tempering small quantities of tools, it is highly important with large production loads. Heat transfer by convection permits heat to penetrate dense loads evenly, as the air can be forced through them uniformly. Consequently convection (supplying the uniformity and economy that radiation lacks) is, of the two methods available, the one scientifically adapted to production tempering.

The equipment, then, well adapted to meet the ideal conditions is a well-insulated electric furnace, designed to minimise

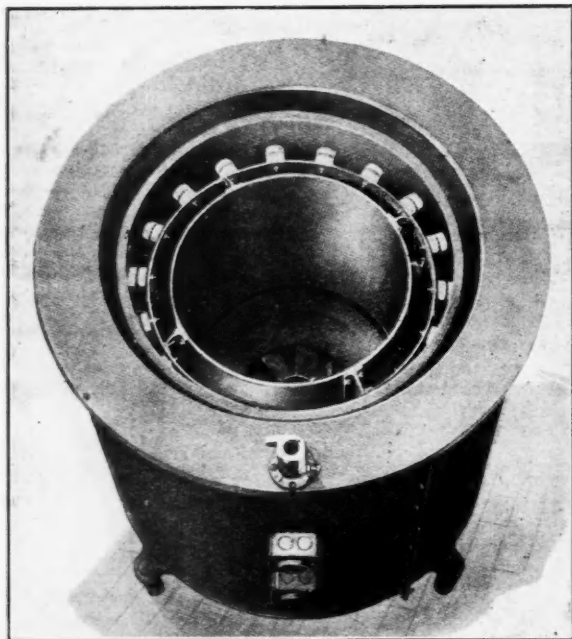


FIG. 1.—THE HOMO ELECTRIC TEMPERING FURNACE.

work; a source of heat; a method of heating; control of the process; and automatic recording of each batch.

Transmission of Heat

The cheapest, handiest medium for transmitting heat to the work is air. If it can be made to conform to the requirements, it is the ideal medium. It involves no cost and requires no handling. It does not deteriorate. It gives off no fumes. It is non-combustible. It does not cling to the work and require cleaning. It offers no objection to placing the drawing equipment using it directly in the line of production.

Electrical energy, of all the various heat sources, can be conveyed without labour through wires run to the most convenient point for the drawing equipment installation. It is most susceptible to sensitive control. It is clean. There need be no fire risk. It is superior to every other source of heat for the purpose, except in one particular—cost per unit of heat produced. However, it lends itself so perfectly to use inside thoroughly insulated equipment of low heat capacity that it becomes more economical than cheaper fuels. Therefore, a well-insulated electric furnace, using air as a

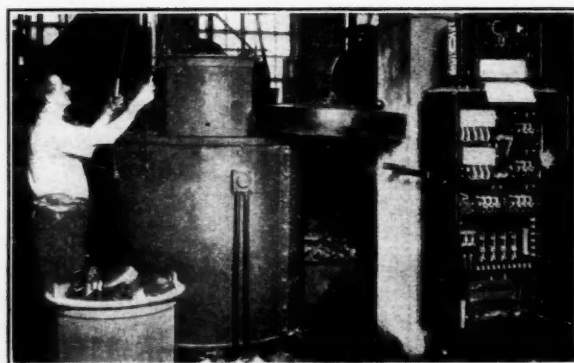


FIG. 2.—TEMPERING THIN METAL PARTS BY THE HOMO METHOD

radiation and conduction to the work and to apply convection, with air as a heating medium, provided this be done rapidly under sensitive, automatic control, be operated in accordance with a prearranged schedule and produce records of each batch.

Basing their work on the above considerations, the Leeds and Northrup Co., whose British agents are The Integra Co., Ltd., 183, Broad Street, Birmingham, have evolved the Homo method of tempering steel. This involves the use of the Homo electric tempering furnace, shown in Fig. 1. The Homo electric tempering furnace is a forced convection furnace, using air as the heating medium. A basket containing the work is lowered inside a cylindrical wall that forms the inside of the furnace. The basket is open at the top. Its bottom is a heavy grid. Below the basket is a fan, driven by an external motor that reverses automatically. Between the inner cylindrical wall of the furnace, which closely surrounds the basket, and the heavily insulated outer wall is an air space. In this space heating coils of nickel-chromium wire are supported between insulating clamps. The fan, reversing at short intervals, drives the air up through the coils and down evenly through the load, then down through the coils and up through the load. Uniformity and control are practically perfect.

The complete equipment for the Homo tempering method consists of the above electric furnace, two baskets, a single-point recording potentiometer controller and an automatic control panel. Control is maintained automatically by a recorder controller. A front setting device enables the operator to select any temperature desired, after which the recording controller automatically varies the power input from the maximum needed to bring the temperature up at the proper rate, to the minimum required to hold it at the exact point selected for the period desired. The controller also operates an automatic switch by which the fan in the furnace is reversed at regular intervals. An automatic record is made of each drawing operation to compare with the master, or to use as a master. Thus, the Homo method provides a definite record of the drawing operation and makes possible the selection of the exact time-temperature combination for best results under any particular working conditions.

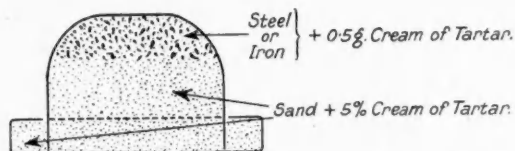
The operator can reproduce with certainty the exact drawing conditions selected as standard, and each operation is recorded for easy comparison with the original. This is made possible by the recording controller and automatic control panel. They place the method in a distinct class. A number of installations are in use in this country. In Fig. 2 the actual use of the method is illustrated.

Determination of Sulphur in Steel, etc.

A Note on the Evolution Method

THE organisers of the British Chemical Standards Movement have been pointing out for some time that all carbon steels and cast iron in the form of millings, drillings, etc., after being in contact with air for a considerable period—usually at least two years—even when stored in a sealed container, and while still remaining bright, cease to yield the full quantity of sulphur as sulphide when dissolved in hydrochloric acid. The result in such a case is that the standard value for sulphur as determined by the evolution method is low; and this can only be remedied by annealing the drillings, etc., in an oxygen-free atmosphere, such as carbon dioxide or nitrogen, before making the determination.

This is not ordinarily carried out with ease in a works laboratory, so that the following simple procedure has been devised:—Mix 5 grams of the drillings with 0.5 grams of dry powdered cream of tartar placed in a porcelain crucible of 1½ in. diameter at the top and ¾ in. high, which is then filled to the brim with a mixture of 95 per cent. acid-washed 40 mesh calcined sea-sand and 5 per cent. powdered cream of tartar. Place on it a silica capsule 1½ in. internal diameter and ½ in. deep. Invert and fill in the space on the outside between the crucible and the capsule with the sand-tartar mixture as shown in the sketch.



ARRANGEMENT FOR DETERMINING SULPHUR IN STEEL.

Insert gradually into a muffle at 750° to 850° C.—not hotter, or the glaze will be badly attacked—and when pushed right in, heat for 20 minutes; take out, cool on an iron plate, then put entire contents into a sulphur flask and evolve sulphur as usual with hot strong (d 1.16) hydrochloric acid. A blank should be carried out on the reagents to make sure that they do not yield any sulphur as sulphide when treated according to the test. Cream of tartar is usually free, but sand, even after washing, has been found to contain a little sulphur, which will be reduced to sulphide, and must be allowed for.

At the headquarters of the British Chemical Standards Movement, after carefully making a number of tests on different standards, the accuracy of the process has been established. White iron and certain alloy steels which do not yield all their sulphur as sulphide by direct evolution may also be treated successfully by this method. As further confirmation of the application of the method for white iron,

it has been submitted to two different chemists experienced in the analysis of these irons—namely, Mr. R. D. Dick, of Pease and Partners, Ltd., Normanby Iron Works, Middlesbrough, and Mr. A. E. Peace, of Leys Malleable Castings, Ltd., Derby; in each case, several tests on white irons have been in close agreement with the gravimetric method, whilst the ordinary evolution process without annealing has given low results.

Annealing with cream of tartar, etc., has, of course, been recommended for years, but the methods of carrying it out have not been satisfactory on account of the uncertainty of ensuring complete freedom from oxidation. The only new feature about the present method is the simple and sure means employed to avoid oxidation.

Sources of Sumerian Metals

WITH regard to the British Association Research Committee's interim report on the sources of Early Sumerian copper and bronze (to which some reference was made in this supplement in October), Professor B. W. Holman, of the Royal School of Mines, says, in the course of a letter to *Nature* :—

"I should like to direct particular attention to the ancient workings for tin about Rooiberg and Blaaubank in the Transvaal. The quantities of bronze now known to have been employed in early times would have involved very considerable ancient workings of copper nickel deposits if the nickel found in such bronzes had been mixed with the copper. The few deposits of nickel and copper in Europe are not associated with ancient workings, whilst the chief ancient workings for copper in Europe and Asia are not associated with nickel.

"In the Transvaal, on the other hand, nickel occurs in the same areas as the tin, and ancient smelting has been carried on there on an immense scale. An examination of the slag by H. S. Gordon has shown that the ancients smelted there for the direct production of bronze—i.e., they brought their copper ore to the tin- and nickel-bearing areas of the Waterberg. Some investigators have estimated the production of bronze and tin in the Transvaal as totalling millions of tons. Such a production is utterly in excess of any possible local demand and indicates a distribution of the metals throughout the Old World.

"It is the large scale of production in Southern Africa (in one single area there are said to be remains of forty-three furnaces) which points most to this area being the main source of the production of bronze in early days. No large ancient slag heaps from the smelting of tin and copper have been found elsewhere. A reprint of the papers already published locally on these workings, and a special request for more local information, would afford an interesting item for discussion at the forthcoming meeting of the British Association in South Africa next year."

The Steel Merger

SHAREHOLDERS of Cammell Laird and Co. on Monday ratified provisional agreements for the concentration of the commercial steel interests of Vickers, Vickers-Armstrong, and Cammell Laird and Co. in a new company, and also the concentration of the railway carriage and wagon manufacturing interests of Vickers and Cammell Laird. Mr. W. L. Hitchens, the chairman, said their object was to sort out the different forms of activity in which they were engaged, and classify them on more scientific lines. At the end of the war there was not enough work for steel concerns, and that over-capacity was increased by the policy of self-determination which had been adopted in most countries. In order to meet the stationary contracting conditions it was necessary to make bigger combinations, so that, instead of putting down a large number of new plants, it would be possible to put down a smaller number calculated to suffice for the amount of work which was likely to be done. Rationalisation meant that businesses which were doing a kindred kind of work got together with the object of securing greater economy and efficiency. The amalgamations now proposed were only a first step. He should not be satisfied if the policy that shareholders were asked to accept remained where it was. Already negotiations were proceeding in other directions, and there was more reorganisation to be done within groups that were now being formed.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

The Institute of Metals

THE council of the Institute of Metals has found it necessary to alter the date of the twenty-first annual general meeting and "coming-of-age" celebrations of the Institute, from that originally announced (March 6 and 7) to March 13 and 14 next. In addition to a dinner and dance at the Trocadero Restaurant, London, on March 13, an interesting function is being arranged for the second day of the meeting. This is a *conversazione* and exhibition to be held in the Science Museum, South Kensington, on March 14. Objects of special interest in relation to the work of the Institute will be displayed; offers of such objects are invited, and should be made to the secretary, Mr. G. Shaw Scott, M.Sc., 36-38, Victoria Street, Westminster, London, S.W.1.

The Annual May Lecture of the Institute is to be given on May 7 by Sir Oliver Lodge, F.R.S. The Annual Autumn Meeting will be held in Düsseldorf next September. Offers of papers for that meeting are invited by the Council, which, it is understood, will particularly welcome papers dealing with matters of practical interest. It is proposed also to hold at Düsseldorf a general discussion on laboratory methods of metallurgical research, in which speakers from many countries are expected to participate.

Production of Magnesium

A VERY considerable degree of secrecy continues to be displayed as to the amount of magnesium made annually, which suggests that, from the munitions point of view, this metal and its alloys are probably being used a good deal more than might be thought. In general applications, however, magnesium appears to be "coming on" rather more slowly than was to have been expected, and it is doubtful if more than about 1,000 tons or so are made per year. In America, its price has gone up, which is a disadvantage. What is badly needed, to cheapen it and make it popular, is a commercially economic process for making it from magnesite, rather than to be compelled to depend upon carnallites of the Stassfurt kind, or on chlorides derived from brines, as used in the American magnesium industry. Even then, the consumption of electrical energy in electrolysis of the fused chlorides is very heavy, which militates against its extended uses. The metal, however, continues to attract the interested attention of many metallurgists, and its literature is slowly growing.

The Casting of Elektron

THE paper read before the Co-ordinated Societies in Birmingham last month by Mr. E. Player can hardly be said to have dealt with magnesium itself, as it was devoted mainly to Elektron. It was certainly the best and most authoritative piece of work on that alloy that has ever been published, and a model of what a paper on a technological (as distinct from a scientific) subject should be. Mr. Player kept nothing back. The information as to the special flux used to protect the surface of the molten alloy was of special interest. Perhaps the most interesting part of the paper was the description of the way in which sound Elektron castings can be made by using powdered sulphur on the surface of the sand moulds and cores. The affinity of molten magnesium for moisture is so great that, with ordinary green sand moulds, combination takes place with explosive violence, while there are difficulties in the way of drying the moulds, owing to the dehydration of the clay and the consequent deterioration and weakening of the bond. There was a touch of genius in the method eventually adopted, which was to surround the sand in immediate contact with the metal with a pellicle of sulphur, which is quite inert to magnesium and to Elektron, in which, of course, magnesium predominates enormously. That Mr. Player's paper was warmly appreciated was evident from the discussion which ensued, and this was none the less illuminating from the fact revealed that most of those present knew very little about Elektron and even less about magnesium. It is well that in his paper Mr. Player scotched at least two common superstitions, namely, those of the alleged danger from fire, and those relative to corrosion, both of which are usually unduly stressed.

Aluminium-Silicon Alloys

ALTHOUGH a great deal of research work has been done and many papers read on aluminium-silicon alloys, the value of such alloys is insufficiently appreciated by engineers and others, and it is well that attention should be directed to the valuable paper by Mr. R. B. Deeley, read recently before a joint meeting of the Institute of British Foundrymen and the London Section of the Institute of Metals. In the early days of these alloys, trouble was experienced owing to blow-holes, but the work of Pacz, after whom the well-known alloy Alpac is named, supplied a remedy for this state of affairs, and it is now claimed that the silicon-aluminium series comprises some of the "strongest" of all aluminium casting alloys. The modification he introduced by treating such alloys with fluorides results in a light, dense and fine-grained structure which has been explained differently at different times, and the cause of formation of which is still rather controversial. The "colloidal" explanation put forward by Dr. Gwyer corresponds best with the facts, and is fairly generally accepted. As now carried out, "modification" is effected by adding the modifier—in this case the silicon—to the metal, but without stirring and with very careful attention to the temperature of the metal, which has to be adjusted to the specific purposes for which the casting is intended, and which is controlled more particularly by the requirements of the thinnest sections. The most satisfactory results are obtained when the proportion of silicon in the final alloy ranges between 10 and 14 per cent. Mr. Deeley's paper deals minutely with the variables of the process and shows how they affect the mechanical and other properties of the ultimate casting. The 14 per cent. silicon alloy he described as a "borderline" alloy from which an all-eutectic structure could be obtained, but great care had to be exercised in using it, or the elongation might suffer somewhat severely. The adaptability of the aluminium-silicon alloys was illustrated by Mr. Deeley in a number of slides showing automobile and railway carriage parts and vehicles which it would be very difficult to cast as effectively in other alloys.

Substitute Metals

THERE is some prospect of dear copper in the immediate future, owing to the control now exercised in America, by way of restriction of output and regulation of prices. Nickel interests seem to have been effectively "merged," and combines have been formed, or are looming, in lead and zinc. Tin has been "dear" for some time, and the whole situation in regard to the main non-ferrous metals is somewhat obscure and perplexing. It is never very safe, where metals are concerned, to raise prices too greatly; the results are to stimulate greatly research work and "substitution." Tin is, in many of its chief applications, seriously challenged by aluminium, and the position of copper is by no means supreme even in electrical work, where aluminium is competing very strongly with it. In domestic appliances the light metal has similarly ousted, to a considerable extent, the heavier red one. Nickel has, for plating, a very serious rival in chromium, upon which a very great deal of research work has, during the last three or four years, been focussed. Finally, zinc is threatened by cadmium, and only the market conditions in respect of that metal have prevented the rivalry becoming very acute. The metals and their alloys possess properties which grade off so imperceptibly that it is safe to say that a substitute for almost any one of them can be found, and when found, research and investigation serve to render the substitute as suitable, for a given purpose, as the metal it tends to supersede. Only a very few, like the platinum group and mercury, are in an unassailable position, because there is no other metal that can take their place.

Foundry Fumes and Rubber

A GOOD many complaints are being heard of the objectionable fumes emitted from foundries consequent on the use of certain types of core-binders. In the circumstances it is curious to note that the U.S. Bureau of Standards has been experimenting in rubber binders, and that in its interesting Circular (No. 252) there is no mention made of the fume nuisance, which one would be almost inclined to regard as

inseparable from the use of rubber in the foundry. Apart from this there is little doubt that rubber (balata is the variety recommended for the purpose) should be very effective as a binder. The Bureau says that cores into which it enters crush readily and can be poured out easily, instead of having to be dug out; that they are much stronger than green sand cores and require only to be air-dried, and not oven-baked; and that they possess high permeability and remarkable freedom from blowing. The binders advocated consist of rubber, or of balata, or a special commercial type of rubber cement, each dissolved in a suitable solvent, such as gasoline for plain rubber, and benzol for balata and for the special cement. The fire-hazards attendant on the use of such binders are high, and one would imagine that the fumes would require to be specially dealt with, thus entailing some expense which might not be compensated for by the advantages promised. The core sand used with these rubber binders should either be free from clay or very low in it.

Case-hardening by Nitrogen

A GREAT deal of interest has been aroused by the announcement, a short time ago, that the nitration process of case-hardening of steels had become available in this country. The rights for the nitration process, and also for the special Nitralloy steels required in connection therewith, for the British Empire are held by Nitralloy, Ltd., of Norris Deakin Buildings, Sheffield. The licensees of the latter for the supply of Nitralloy steels are John Brown and Co., Ltd., of Sheffield, and Thomas Firth and Sons, Ltd., of Sheffield. Nitralloy, Ltd., are prepared to grant licences for the use of their process to any users who may wish to carry out their own case-hardening by nitrogen.

Details of the Method

It has been known for some time that iron and steel absorb nitrogen when heated in ammonia. At first the nitrogen was considered to have merely a harmful effect. It was later found that by the use of certain special steels a thin case of solid solution of nitrogen was formed, of great hardness, and its hardness gradually diminished inwards, so that the case was solidly merged into the core, giving full assurance against peeling. Further investigations finally brought forth the case-hardening process. This process has already found very wide application in Europe and the United States of America, and its field of usefulness is rapidly extending.

The nitration process consists in subjecting finish-machined parts made of the special steels, known as Nitralloy steels, to the action of ammonia gas in an electric furnace at a temperature of 500° C. for the length of time necessary to produce the depth of case required. The full period of ninety hours' nitration produces a depth of case of 0.031 in.

Advantages Claimed

VARIOUS advantages are claimed for the process. There is no distortion of parts during nitration and no deformation. Parts are nitrated in the finish-machined condition, and in many cases are immediately ready for service. They swell slightly during nitration (about 0.001 in. on diameter), but this effect is regular and uniform, and due allowance can be made for it. Intricate designs, it is stated, can be safely treated by this method, thus opening up the field to such parts as worms.

The hardness obtained by nitration is such as to cut glass, and even quartz; it cannot be touched with special testing files. The following table of hardness is of interest:—

SUBSTANCE.	BRINELL HARDNESS.
Nitrated Nitralloy Steel	900-1,100
Cr. Van. (-50 C., 1.00 Cr., .20 Van.), C.H.	742
H.S. Steel Tool Bit, hardened	675
1.25 per cent. Carbon Tool Steel	627
Tool Steel (12 per cent. Cr., 1 per cent. Van., 2 per cent. C.) ..	627
Chrome Magnet Steel (C. .85, Cr. 2.75)	627
.80 per cent. Carbon Tool Steel	555
4 per cent. Nickel Chrome Steel (C. .60, Cr. 1.0 per cent.) ..	555
Hard White Iron	450
Hard Cast Iron	210

Wearing and Corrosion-Resisting Properties

GREAT resistance to wear is claimed for nitrated steel, *i.e.*, eight to ten times that of cemented and quenched steels.

The nitration case retains its hardness up to 500° C. The nitrated case has considerable resistance to the corrosive action of fresh or salt water and moist atmosphere. Tests have recently been completed on water pump shafts for motor cars, and after one hundred hours' running at 75 m.p.h. the results were as follows:—

Nitralloy steel shafts, properly nitrated. No loss of weight whatever. Loss in diameter too small to be determined by micrometer measurement.

Stainless iron shafts, chrome plated shafts, and case-hardened steel shafts were all worn to a point beyond further use.

Nitralloy Steels

A RANGE of grades of Nitralloy steels has been produced to meet the various requirements as to core strengths in the different classes of service and manufacture. Nitralloy steels contain a certain percentage of aluminium, both on account of the action of aluminium in the formation of the extremely hard surface on the steels when submitted to the action of the nitrogen during nitration, and also because of the excellent physical properties produced in the core. The variations in the carbon contents of the Nitralloy steels are governed solely by the mechanical properties required from the steel forming the core, as the percentage of carbon within normal limits does not affect the hardness of the case produced by nitration. Too high a percentage of carbon may, however, be prejudicial to the production of the very best results. The hardness figures are the same for all grades of Nitralloy steels. Six grades of Nitralloy steels are at present available, with carbon contents ranging from .20 per cent. to .65 per cent.

Working of Nitralloy Steels

THE physical characteristics of the Nitralloy steels are similar to those of highest quality nickel chrome steels, and it is possible to obtain the tests required in the core of parts by a suitable heat treatment, these tests not being affected by the subsequent nitration at 500° C. The working of Nitralloy steels is in every way similar to that of nickel chrome steels, and they have excellent forging properties, and machine satisfactorily in both the annealed and the heat-treated conditions. The Nitralloy steel of suitable grade must be heat-treated to impart the desired physical properties to the core, and then machined as usual. Before nitration, the strains set up by forging, rolling or machining must be relieved, by annealing at 540° C. for about five hours, advisably between rough and finish-machining. If all strains are removed, the parts after nitration will be free from distortion or irregular growth. A very high degree of mirror finish can be obtained on Nitralloy steels without difficulty.

The Nickel Fusion

IT is officially announced that a provisional agreement has been made between the International Nickel Co. of Canada and Lord Melchett, Mr. Henry Mond, and Mr. David Owen Evans on behalf of the Mond Nickel Co., for the exchange of Mond Nickel shares into stock of the Canadian company. The agreement takes the form of an offer from the Canadian company to accept the exchange provided 75 per cent. of the ordinary shares of the Mond Nickel Co. are deposited, or by mutual agreement between the Canadian company and a majority of the three Mond signatories if any less amount of ordinary shares is deposited. January 18 is the latest date fixed for the acceptance of the offer, but it may be extended for thirty days by mutual agreement. As has been stated on previous occasions, the 7 per cent. preference shares of the Mond Nickel Co. receive similar shares of \$5 of preferred stock in the Canadian company, plus a cash payment of 2s. 6d. for the class that is at present entitled to 30s. per £1 in a winding up. The ordinary 10s. shares receive one share of no par value in the fully paid common stock. When the provisional agreement becomes binding it is stated that there will be a fusion of the interests of the Mond Nickel Co. with those of the Canadian company. No estimate of dividend is given, but it is stated that the combined net profits of the two companies during their last financial years would cover the dividend on the 7 per cent. preferred stock of the new Canadian company over four and a half times.

Trade, Commerce, Finance: The Month in Review

From Our Market Correspondent

ONCE again we have reached the year-end, and we turn our backs on the uninspiring record of the year 1928. The experience of the iron and steel industry during that year has not been very satisfactory. Trade settled down to a dull level in the early part of the year, and has never since risen above that level. The struggle to wrest success out of difficult and adverse conditions has been as keen as ever, and no easing up has been possible. At the end of the twelve months it is doubtful if any real progress has been made or can be made along the lines in which the industry has settled down.

The seasonal activity which one might reasonably expect towards the end of the year has not been very pronounced; indeed, December has shown no improvement over preceding months, markets have been generally dull and trade quiet. Naturally, the Christmas holidays had a somewhat quietening effect, although not quite so much as usual. With Christmas falling in mid-week, the whole week has been a general holiday throughout the industry, as it was no use starting up the furnaces either at the beginning or the end of the week, and production has been almost entirely suspended. In view of the long stoppage a good volume of specifications was placed with the mills so as to ensure early delivery on the resumption of work, and consequently there will be a sufficient weight of orders on hand to give a good start in the New Year.

Better Anticipations

In anticipation of this a better tone has recently pervaded the markets and there seems to be a general expectation of a slight improvement in trade. At present there is nothing substantial on which to build such hopes, but, nevertheless, the feeling is there and one can only hope that the anticipation will soon become realisation.

Actually, the difficulties of the steel makers are increasing. They are faced with a definite increase in the cost of manufacture from the commencement of the New Year, owing to the higher prices which have had to be paid for renewals of contracts for coal, coke, and scrap, three very important elements in the cost of production. It is no use trying to resist these advances. There is a shortage of coke, and the supply of coal is not more than sufficient to meet the demand, thanks to the coal control scheme which is now operating in several of the chief mining districts, and which is likely soon to be extended to other districts.

It is true that the collieries and coke ovens have had a very lean time, and by the help of the control scheme they are making an endeavour to recover some of their former prosperity. The present advance in coal and coke prices is not great in itself, varying from 9d. to 1s. per ton, but on the finished steel products it means some shillings per ton. Added to this is the increase in the price of scrap, which has risen at least 2s. 6d. per ton and is likely to go still higher, owing to the fact that large quantities of the best scrap are being exported to the Continent at more remunerative prices than those ruling in the home market.

Higher Selling Prices Possible

There is no margin in the present selling prices of steel to cover any advance in the cost, and the makers will be compelled to seek compensation in higher selling prices. So far nothing has been done with regard to the official prices of the controlled materials, but the next joint meeting of the associations is awaited with interest, and it will not be surprising if an advance is announced. In the uncontrolled materials there are already signs that the long spell of unrestrained price-cutting is over, and attempts are being made to establish prices on a more reasonable and economic basis.

In small steel bars, for instance, there has been a decided hardening in price, and there is no longer any need to accept the ridiculously low figures which were ruling a few months ago. There is a brisk demand for this class of steel, particularly of the better qualities, and the makers who have cultivated the trade in these quality steels are now working at full pressure, with good order books. It is also very probable that the price of boiler plates will be put on a proper basis in the year future, as there is a movement among the makers to

re-establish control of the price of this commodity. Such a step is desirable, as there has been neither rhyme nor reason in the way boiler plate prices have been cut during the past twelve months. If the proposal goes through, the first move will no doubt be a small advance on the present low price.

Competition

It will be a good thing if these movements mean that the steel makers are at last realising and acting on the realisation of the futility of the fierce internal competition which has been so long active. With the productive capacity so much in excess of the demand, it is inevitable that there should be keen competition among the different makers to secure as large a share as possible of the business going, but to carry that competition to the length of cutting prices blindly without any regard to the cost of manufacture is the height of folly, and the only person who benefits in the long run is the consumer, who, in the majority of cases, would have been satisfied to pay the higher price ruling before the makers became busy cutting each other's throats.

The control of the prices of plates and sections has now been effective for a considerable period, notwithstanding the fact that the makers of these classes of steel have been by no means fully occupied. If the control can be effective under such conditions, there is no reason why similar provision should not be made in regard to the other materials which at present are outside the scope of the associations.

The Election and Safeguarding

With the approach of the General Election in June there is much speculation as to the outcome in regard to safeguarding. A significant move has been made by the Labour Party, which may have the effect of postponing this matter for an indefinite period. The Iron and Steel Confederation, which is the largest of the mens' unions in the steel trade, wishes to make a request to the Government for the appointment of a commission to inquire into the state of the industry, and that request has been supported by the T.U.C. There is very little doubt that when the request goes forward with this backing it will be granted, as the Government will welcome the opportunity of shelving the question, and if a commission is appointed there will be no safeguarding for a year or two at any rate.

Rationalisation

Another important step in the rehabilitation of the steel industry has been taken in the amalgamation of the three large concerns, Vickers, Vickers-Armstrongs, and Cammell Lairds. It is well known that Mr. Hitchens, the chairman of Cammell Lairds, has long been in favour of the kind of combination known as rationalisation, and for some years past he has strongly advocated it as the only means of saving the industry from disaster. In the formation of the English Steel Corporation, as the new holding company is called, he has seen the partial realisation of his ideal, and the result will be watched with much interest.

The scheme is to embrace the heavy steel trades, particularly the production of high class forgings, on the one hand, and the production of steel for railway carriages and wagons on the other. Negotiations are in progress for the inclusion of other undertakings besides those announced. It is believed that the full scheme includes the building of an entirely new works on the most modern lines, and that there is plenty of money available in the amalgamation for such a project. A large portion of the trade in the better class of heavy forgings has been in the hands of the Continental makers, and the new Corporation will make it its business to secure as much of this trade as possible for this country. There is no doubt that the idea of rationalisation is gaining ground, and its extension to other branches of the steel industry is likely to follow.

The production of pig iron in November amounted to 544,400 tons, compared with 543,600 tons in October, there being a decrease of one in the number of furnaces in blast. The output of steel was 762,500 tons, compared with 756,000 tons in October.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature, published weekly in THE CHEMICAL AGE.

Chromium

IN the electrodeposition of chromium, the throwing power of an electrolyte consisting of, or rich in, chromic acid is improved by the addition of a small quantity of lithium oxide, carbonate, sulphate, or other salt. No lithium is deposited. The preferred current strength is 4–20 amps. per sq. dcm. and temperature 28–40°C. See Patent Application 299,395, bearing the International Convention date October 25, 1927, by W. G. Poetzsch, of Leipzig, Germany.

Copper

SPECIFICATION 300,701, dated August 19, 1927, describes an invention by T. J. and B. Taplin and Metals Production, Ltd., of London, enabling increased yields to be obtained in the extraction of copper from its oxidised ores or concentrates when the extraction process is of the type described in Specification 250,991 (see THE CHEMICAL AGE, Vol. XV, p. 7 [Metallurgical Section]), viz., heating a mixture of the ore and solid carbonaceous matter in presence of available halogen at a temperature lower than the melting point of copper. According to the invention the reduction-halogenation operation is partially effected and is followed by an oxidation step, whereupon the reduction-halogenation is resumed with or without further oxidation steps before the reduction-halogenation is completed. In the case of ores containing native or sulphide copper a preliminary oxidation step precedes the first reduction-halogenation step.

Heat Treatment of Ores

ZINC and other volatilisable metals are recovered from iron-containing materials such as waste pyrites by mixing the materials with excess, not less than 45 per cent., of fuel and treating in a rotary furnace. Deposition of iron in the furnace is thus avoided, and the residue, after removal of the zinc, etc. by volatilisation, is separated by sifting or by magnetic separation. The treatment is advantageously applied in connection with the process described in Specification 225,842 (see THE CHEMICAL AGE, Vol. XII, p. 138). See Patent Application 299,300, bearing the International Convention date October 22, 1927, by F. Krupp Grusonwerk Akt.-Ges., of Buckau, Magdeburg, Germany.

Iron

IRON ores which in the natural state are non-magnetic, or only feebly magnetic, are transformed into magnetic ores to enable them to be enriched by magnetic separation methods according to a process described in Specification 300,438, dated February 11, 1928, by A. Holmberg of Stockholm, Sweden. The ore, intimately mixed with a pulverulent fuel, is charged into receptacles in which the fuel is ignited and slowly burnt by a supply of atmospheric air and a portion of the escaping combustion gases, the supply of air being so regulated in relation to the latter that the temperature is maintained below the sintering point and a partial reduction of the ore is effected. Producer gas or other combustible reducing gas may be added to assist the reduction.

Iron Alloys

A PIG IRON containing a desired proportion of molybdenum is obtained by adding to the blast-furnace charge a molybdenum compound such as molybdenum oxide or sulphide or calcium molybdate. The product may be used for making steel and for making grey, white, malleable, or semi-steel castings. See Patent Application 299,800, bearing the International Convention date November 1, 1927, by Climax Molybdenum Co., of New York.

Magnesium

REDUCTION of magnesium-containing material at high temperature to produce the metal in vapour form is effected in an electric furnace by means of a gaseous reducing agent, e.g., hydrogen or a gas containing it, which is introduced into intimate contact with the material at such a point that it becomes dissociated or ionised owing to the temperature and the electric field. The gas is supplied intermittently or continuously through a tubular electrode to the electric arc, a refractory mass of the material to be reduced constituting the other electrode. Carbonaceous matter may be admixed

with the material to be reduced, and in this case, if the material contains calcium, calcium carbide is obtained as a by-product. The magnesium vapour may be removed by the stream of reducing gas passing through the furnace and condensed in a non-oxidising atmosphere. See Specification 300,149, dated July 29, 1927, by W. Koehler, of Cleveland, Ohio, U.S.A.

Nickel

ACCORDING to Patent Application 299,375, bearing the International Convention date April 13, 1927, by Soc. Anon. Le Nickel, of Paris, the electrolytic production of metals and in particular of nickel is effected by deposition on wires or thin rods instead of on plates in order to obtain a dense deposit. The cylindrical form of the billets produced facilitates their casting in pots.

Pickling Metals

INHIBITING agents for addition in small quantities to aid pickling baths for iron or steel are obtained by condensing aldehydes with hydrogen sulphide or an alkali metal sulphide. The products are of the type HS, R, SH, in which R is a hydrocarbon residue, e.g., CH₃, or a series of such residues linked by sulphur, e.g., CH₃-S-CH₃ or CH₃-S-CH₂-S-CH₃. In an example, hydrogen sulphide is passed through a 40 per cent. solution of formaldehyde cooled to –10°C. until the increase in weight is about 25 per cent. See Patent Application 298,390, bearing the International Convention date October 21, 1927, by Goodyear Tire and Rubber Co., of Akron, Ohio, U.S.A.

Washing Ores

IN an invention described in Specification 299,750, dated July 30, 1927, by F. L. Wilder, E. Morris, E. Schiff, and E. S. King, of London, loss of valuable materials in the washing of complex minerals preparatory to their concentration is prevented by using a washing liquor comprising a solution containing persulphate and chloride of an alkali metal together with ferric salts, and recovering the metal values from the used liquor. The process is especially suitable for the treatment of ores containing tin. The ferric salts in the washing liquor may be derived at least in part by the initial action of the starting solution upon soluble iron present in the material under treatment, such solution containing preferably about 0.4 per cent. of active or nascent chlorine. After separation of the unattacked material and slimes the solution is treated for precipitation of dissolved metals, e.g., as sulphides, and the remaining mother liquor is then subjected to electrolysis to regenerate the active constituents for use again. Such regeneration may be assisted by introducing sulphur dioxide and/or chlorine during or immediately prior to the electrolysis.

Zinc

PROCESSES and plant for reducing zinciferous materials are described and illustrated in a series of four Specifications, 298,921–4 (Mellersh-Jackson), communications from the New Jersey Zinc Co., of New York, dated July 8, 1927.

According to Specification 298,921, the reduction is effected by causing a charge of agglomerates (formed by coking or sintering) of the zinciferous material and the reducing agent to pass progressively through a long chamber heated to a temperature sufficiently high to effect the reduction and to volatilise the zinc without any breaking down, slagging, or fusion of the agglomerates. The porosity of the charge as a whole must be such that the transfer of heat from the heated wall of the chamber is effected largely by hot gases flowing through the voids of the charge.

According to Specification 298,922, the temperature of the charge of agglomerates does not exceed 1150°C., and the walls of the chamber are for the most part of metal.

According to Specification 298,923 the externally heated reducing chamber is vertical, is supported and tied at its lower end only, and is built up of a multiplicity of pieces of temperature-resistant material fitted together with plain butt joints filled with a material adapted to make the chamber zinc-vapour-tight.

According to Specification 298,924, a porous charge of zinciferous and reducing materials is reduced in an externally heated chamber communicating with a condenser for the zinc vapour, the flow of the vapours into the condenser being induced by stack draught and controlled by maintaining a predetermined gas pressure at one or more appropriate points in the stream of vapour.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

- ALLOYS.—The electrical resistance of some silver alloys. W. Schmidt. *Zeitschrift für Metallkunde*, November, pp. 400-402 (in German).
- Monel metal. I.—Electrical and thermal properties and magnetostriction. A. Schulze. II.—Magnetisation curves of Monel metal. A. Kuzman. *Zeitschrift für Metallkunde*, November, pp. 403-406, 406-407 (in German).
- ANALYSIS.—The present position of the determination of oxygen in steel and iron. O. Meyer. *Zeitschrift angewandte Chem.*, December 1, pp. 1273-1278; December 8, pp. 1295-1298 (in German).

The determination of vanadium in steel. K. Swoboda. *Chemiker-Zeitung*, December 29, pp. 1014-1015 (in German).

- APPARATUS.—Electrical annealing and tempering ovens. A. Herberholz. *Chemische Fabrik*, December 19, pp. 717-718 (in German).

CORROSION, ETC.—A new development in corrosion-resisting steel. F. R. Palmer. *Trans. Amer. Soc. Steel Treating*, December, pp. 877-892, 950. The addition of 0.1 per cent. of zirconium sulphide to a high-chromium stainless iron greatly improves the machinery and grinding properties, and reduces the tendency towards galling, scratching, and seizing. This is accomplished at a slight loss to toughness and tensile properties, but yields a metal eminently suited for corrosion-resisting parts. Zirconium sulphide tends to prevent air hardening in the low-carbon grades of stainless iron and raises the hardening temperature.

The occurrence and prevention of corrosion in boilers. P. Weigleb. *Chemiker-Zeitung*, November 28, pp. 922-923 (in German).

ELECTROMETALLURGY.—The electrolytic refining of bismuth-containing lead. P. Schächterle and W. Riecke. *Metall und Erz*, Volume 25, Part 24, pp. 637-640 (in German). Deals with the preparation of the lead dithionate electrolyte via pyrolusite and iron hydroxide; its suitability for electrolysis; the separation of lead at aluminium cathodes; the action of various added colloids; the cathode lead; and the behaviour of impurities of the lead in electrolysis.

FLOTATION.—The influence of flotation on the development of the metallurgy of copper, lead and zinc. Kirmse. *Metall und Erz*, Vol. 25, Part 23, pp. 603-610 (in German).

An attempt at the elucidation of the processes of flotation by means of osmotic and solution pressure. C. Bruchhold. *Metall und Erz*, Vol. 25, Part 23, pp. 610-618 (in German).

On flotation. J. Traube. *Metall und Erz*, Vol. 25, Part 23, pp. 618-621 (in German). Deals with adsorption intensity and flotation; methods of measuring the intensity of adsorption; the significance of the Langmuir-Harkins theory and of the determination of adsorption intensity for the choice, use, and valuation of oils, etc.

Preliminary communication on a new method of flotation of oxide ores. J. E. Barnitzke. *Metall und Erz*, Vol. 25, Part 23, pp. 621-624 (in German).

GENERAL.—Spectrographic analysis of Irish ring-money and of a metallic alloy found in commercial calcium carbide. A. G. G. Leonard and P. F. Whelan. *Proc. Roy. Dublin Soc.*, September, pp. 55-62. An alloy found occasionally in small quantities in a certain brand of commercial calcium carbide was found to have the composition: silicon, 11.3 per cent.; titanium, 22.0 per cent.; and iron, 66.2 per cent.

"Galvanising" with cadmium. G. de Lattre. *Révue de Métallurgie*, November, pp. 630-636 (in French). "Galvanising" iron and its alloys with cadmium is an efficacious method of protection, more durable than galvanising with zinc.

A new method of nitrogen case hardening. G. F. Bason. *Trans. Amer. Soc. Steel Treating*, December, pp. 932-934. The hardening of collector rings on electrical machinery is believed to be due to bombardment of the rings with nitrogen ions, the surface being thereby

nitrogenised. It is suggested that this might lead to a practical process of nitriding.

GOLD.—The electrometallurgy of gold. W. Graulich. *Chemische Fabrik*, November 28, pp. 678-679 (in German). Calculations for the electrochemical refining of gold according to the Wohlwill process; current use and total potential; daily precipitation of gold; daily loss of weight of anodes; removal of gold from the electrolyte; duration of stay of anodes in the bath, etc.

STEEL.—Decarburisation of high carbon steel in "reducing" atmospheres. J. J. Curran and H. G. Williams. *Trans. Amer. Soc. Steel Treating*, December, pp. 809-830. Carbonaceous packing mixtures may be either carburising or decarburising in their action, according to the activating material used in the mixture and the temperature of heat treatment.

Effect of quenching and tempering on the hardness and impact resistance of a high-chromium silicon steel. F. T. Sisco. *Trans. Amer. Soc. Steel Treating*, December, pp. 859-865. In an investigation of an alloy steel containing 1.2 per cent. of carbon, 1.2 per cent. of silicon, and 18 per cent. of chromium, the best quenching temperature was found to be 1,800-1,850° F.

Silicon-manganese steels with chromium additions for engineering applications. A. B. Kinzel. *Trans. Amer. Soc. Steel Treating*, December, pp. 866-876. Silicon-manganese steels of medium carbon content are highly suitable for engineering purposes and are susceptible to heat treatment. Silicon-manganese-chromium steels are superior to silicon-manganese or straight manganese steels similarly heat treated.

Heating high-speed steel to 2,400° F. in molten lead. W. C. Searle. *Trans. Amer. Soc. Steel Treating*, December, pp. 927-931. This method of high-speed steel hardening is simple and satisfactory for moderate production. There is little danger of destroying delicate edges before the tool is heated through.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ASIUM ALLOYS, LTD., London, E.C. Registered November 22, £500 debentures, part of £2,000; general charge.

BALDWINS, LTD., London, E.C., coal and iron masters. Registered December 11, Trust Deed dated December 8, 1928, securing £1,000,000 1st debenture stock and premium of 2 per cent.; charged on properties at Panteg, etc., and certain investments, also general charge. *£2,649,100. December 14, 1927.

BARROW HAEMATITE STEEL CO., LTD. Registered November 22, supplemental Trust Deed dated November 16, 1928, securing payment of interest in respect of certain interest not paid, etc., on 5 per cent. (income tax free) 1st debenture stock of the company; charged on property comprised in Trust Deeds dated June 10, 1919, etc. *£1,117,389. March 14, 1928.

SHEEPBRIDGE COAL AND IRON CO., LTD. Registered December 5, £100 and £1,000 debentures, part of £750,000; general charge (except uncalled capital and certain property). *£580,050. October 10, 1927.

Satisfactions

BWANA M'KUBWA COPPER MINING CO., LTD., London, E.C. Satisfaction registered December 1, £10,425, part of amount registered April 13, 1928.

WOLSTANTON, LTD., Wolstanton, ironmasters. Satisfaction registered November 22, £81,200, registered February 18, 1922, and April 28, 1927.

Monthly Metallurgical Section

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NOTICE.—Communications relating to editorial matter for our *Monthly Metallurgical Section* should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

Metallurgical Research of the D.S.I.R.

Annual Report on Work Done

The report of the Department of Scientific and Industrial Research just issued (H.M. Stationery Office, 4s.), which covers the year ending July 31, 1928, contains much information of interest to metallurgists. The more important points are noted below.

DURING the year the committee for scientific and industrial research of the Privy Council received a report from its advisory council on certain proposals for metallurgical researches in which they called attention to the considerable expenditure by Government on researches in metallurgy, and recommended the appointment of a Metallurgy Research Board with the following terms of reference: (i) To review periodically all metallurgical research in progress in Government establishments or aided by Government grants, and to make arrangements for interchange of information and for co-operation with industry; (ii) To make arrangements for the supervision of any metallurgical researches carried out by the D.S.I.R. on the recommendation of the advisory council, other than those under the direct control of the executive committee of the National Physical Laboratory; and (iii) To report to the council on all proposals for further work by the D.S.I.R., on the expenditure involved, and on the progress of current work.

This recommendation was approved, and a board with the following members was appointed: Professor H. C. H. Carpenter (chairman), Dr. R. S. Hutton, Sir William Larke, Dr. H. McCance, Dr. W. Rosenhain, Sir Thomas Stanton, Mr. B. Talbot, Professor G. I. Taylor, Captain J. H. Harrison (Admiralty), Dr. H. Moore (War Office), and Mr. D. R. Pye (Air Ministry).

Behaviour of Alloys at High Temperatures

The advisory council have also had under consideration the progress of the work supervised by the committee on the behaviour of alloys at high temperatures, and in recommending approval of a programme of further work, they advised that it was desirable to reconstitute the Committee with the following terms of reference: (1) To determine the properties of existing alloys intended for use at high temperatures; (2) To undertake investigations of a more fundamental character with a view to correlating the structure and constitution of alloys with their behaviour at high temperatures; and (3) To undertake in co-operation with industry, exploratory work upon alloys (including alloys for use in high pressure steam plant) to discover new types suitable for use at high temperatures.

The personnel of the reconstituted committee is as follows: Engineer Vice-Admiral Sir Robert Dixon, Professor C. H. Desch, Mr. S. B. Donkin, Dr. R. S. Hutton, Sir William J. Larke, Dr. W. Rosenhain, Sir Thomas Stanton, Mr. E. B. Wedmore, Engineer Captain H. A. Brown (Admiralty), Mr. R. H. Greaves (War Office), Mr. D. R. Pye (Air Ministry), with an assessor appointed on the nomination of the Board of Trade.

During recent years, a number of alloys which show considerable strength at high temperatures have been introduced, and are now used in many branches of engineering. Of existing alloys, the improved steels have been mainly due to industrial research in this country, whereas the non-ferrous alloys owe their introduction largely to research abroad. The exact knowledge of the properties of these alloys is of great importance to engineers, and considerable attention has, therefore, been given at the National Physical Laboratory to the design of apparatus to give accurate data of the "creep" of metals up to temperatures of the order of 1,000° C.

A detailed study has also been begun of the mode of deformation and fracture of metals at high temperatures, both under rapid and prolonged loading, and more recently the effect of intermittent loading is being examined.

Uses of the Alloys

The use of these new alloys has facilitated advances in engineering in many directions. They have made possible the improvement of the efficiency of power generating plant. They are used to a large extent for such purposes as electrical heating, and are essential for the modern heavy chemical industry. There is no reason to believe that the industrial successes so far obtained, striking as they are, indicate anything more than the opening up of a fresh field of industrial development. There is little knowledge of those ultimate properties of alloys and metals on which strength at high temperatures depends, and much work has already been carried out at the National Physical Laboratory in the hope of throwing light on this fundamental question.

A general investigation has been made of nickel chromium alloys for the purpose of correlating the structure and constitution of these alloys with their behaviour at high temperatures, and although the object of this work is primarily to obtain the kind of scientific information which would be useful in guiding and foreshadowing industrial advances, it has already had a practical outcome in demonstrating the superiority of alloys of nickel with 30 and 40 per cent. of chromium to the 20 per cent. chromium alloys which are now in commercial use.

Research on Minor Metals

The object of the work on minor metals undertaken at the National Physical Laboratory under the general direction of the Minor Metals Research Committee, which was begun in 1922, was to provide more complete data on those metals, such as cadmium, which already find a limited use in industry, and to explore the properties of metals hitherto unused, in the hope that the information so obtained might stimulate industrial developments of minerals occurring in the British Empire. A considerable amount of work has been carried out on the properties of cadmium and its alloys. This metal is available as a commercial product in a state of comparatively high purity, and is already used to some extent, notably in the form of an alloy of 1 per cent. of cadmium with copper, which is superior to copper itself for conductors, such as trolley wires, where tensile strength is important.

A detailed study of the constitution, structure and physical properties of the alloys of copper and cadmium has been carried out and the results published. The effect of cadmium in alloys of copper and zinc has also been investigated, with the result that it has been definitely shown that the presence of small quantities of cadmium in brass is not deleterious, as was formerly believed. This is a result of considerable economic importance. The alloys of cadmium and zinc have been thoroughly studied, and particular regard paid to the possible use of certain of them as solders. Such solders have a greater strength than those of the lead-tin series, and they have a higher melting point, which is, however, sufficiently low to allow high-duty steels to be soldered without detriment to their quality.

Beryllium

The Committee has also paid much attention to the possible uses of beryllium. At the time when the work at the National Physical Laboratory was begun, beryllium could not be obtained except in the form of an impure powder, and it was found necessary to develop methods of production at the National Physical Laboratory. These methods have been successful in providing beryllium metal in a high state of purity, and it is believed that the experience gained will be of considerable value if beryllium is ever manufactured on a large scale in this country. It is extremely difficult, however, to produce the metal free from traces of oxide, and although chemical analysis indicates that the total amount of impurity present is small, there is ample evidence that it is sufficient to affect quite definitely the properties of the metal.

For instance, the beryllium obtained at the laboratory is brittle, and so far as is known no ductile specimens of beryllium have yet been prepared. There is no reason to believe that this is an essential property of beryllium; on the contrary, X-ray analysis of its crystal structure indicates that it is likely to be ductile in the pure condition. As is well known, recent work has shown that metals such as zirconium and titanium, which were formerly believed to be brittle, are ductile when obtained in a state of sufficient purity.

Beryllium is a much lighter metal than aluminium; it has considerable strength, a high melting temperature, a low coefficient of thermal expansion, and is not easily corroded when exposed to ordinary air. If it were available in sufficient quantities, it would find a large number of practical uses. The cost of the raw material beryl is at the moment very much higher than the cost of the ores of the other lighter metals, magnesium and aluminium, but it is quite possible that it exists in larger quantities and in wider distribution than is at present thought.

Alloys of Beryllium

The work on alloys of beryllium with aluminium has given somewhat disappointing results. It has been shown that the mechanical properties of these alloys are unlikely to be valuable. There is no evidence that an alloy of beryllium with aluminium will be superior to other aluminium alloys, unless experience shows that their lower coefficient of expansion is of importance for special applications. Alloys of beryllium with iron have, on the other hand, given very promising results.

Great attention is being given by some foreign manufacturers to the possible uses of beryllium alloys, whereas there appears to be almost a total absence of interest in them in this country. At the recent exhibit of engineering materials at Berlin, a number of interesting specimens of alloys of beryllium with copper were shown. A number of patents have also been taken out in Germany on the use of beryllium in the manufacture of alloy steels.

Light Alloys

The light alloys research at the National Physical Laboratory has continued during the past year. The mechanical properties and microstructures of electron alloy as supplied commercially have been investigated, the tests including tensile, impact, hardness and fatigue tests at air and various elevated temperatures.

Experiments have shown that the normal period of soaking chill-cast test bars of "Y" alloy before quenching can be shortened in some cases, with the object of cheapening the cost of production. The experiments relate to small test bars, and it is not certain whether the results are wholly applicable to large castings. Other tests of Y-alloy have been made at tempering temperatures of 200° C. and 250° C. under conditions similar to those previously carried out at lower temperatures. 200° C. tempering produces superior tensile strength and hardening, but another 50° was found to be too high, as elongation was then seriously reduced.

Further work will proceed on the constitution and structure of aluminium alloy systems, with special reference to age-hardening and modification; and work will be directed to alloys containing thorium and silicon. The permanence of dimensions of large forged bars of various light alloys will also be investigated.

Fatigue of Materials

Considerable progress has been made at the National Physical Laboratory in the investigation on the deformation of single metallic crystals. Joint experiments have been carried out by Professor G. I. Taylor at Cambridge and at the National Physical Laboratory to determine whether reversed slipping occurs on the slip planes of a single crystal of aluminium subjected to alternating stresses. Professor Jenkin has continued his researches at Oxford on fatigue at high speeds and on fatigue in the presence of corrosive agents. In his high-speed experiments Professor Jenkin, using methods for producing high strain by air-forced vibrations, has broken specimens at speeds as high as 10,000 vibrations per second.

Electro-Deposition

Investigations on electro-deposition have been continued, under the supervision of a committee of the D.S.I.R. containing representatives of industrial interests, at the Research Department, Woolwich, the Royal Aircraft Establishment, Farnborough, and Sheffield University. Very satisfactory progress has been made at Woolwich with the investigation into the causes and prevention of pitting in electro-deposited metal.

The work undertaken at the Royal Aircraft establishment upon the deposition of zinc on aluminium as a protection against corrosion, has been continued throughout the year, and experiments have also been made with steel, brass and copper as basis materials. The investigations at Sheffield have mainly dealt with the production of nickel deposits with less internal stress than is usually present. The effect of alternating current superposed on direct current has been studied in detail and also the influence of deposits under various conditions of stress on the fatigue strength of steel test pieces. An investigation of the electro-deposition of silver from sodium cyanide baths, and of the effect of substituting sodium for potassium cyanide in existing baths has now been completed.

Experimental work on the deposition of nickel from solutions of nickel salts containing small quantities of iron is being undertaken on behalf of the Committee at the Sir John Cass Institute under the supervision of Dr. H. J. S. Sands.

Work of the Non-Ferrous Metals Research Association

The D.S.I.R. report includes accounts of the work of the research associations. From the outset, the British Non-Ferrous Metals Research Association has devoted its main efforts to carrying out experimental research on major problems. Arising from a study of lead made by the Association, a series of new alloys has been discovered which are already finding extensive application for the sheathing of electric cables and appear to offer valuable prospects for use in other lead products. The Post Office has given orders for two submarine cables to be sheathed with these alloys and the Admiralty has adopted them as a tentative standard for cable used on His Majesty's ships. In these applications it is the high fatigue resistance which is chiefly of value, since this renders the cables much less susceptible to breakdown by vibration. The alloys, however, also possess much greater strength than pure lead, and it is anticipated that this will render them of use for pipe and sheet manufacture.

The Association has failed to awaken the interest of, or even to secure an examination of its discoveries by, the representative body of the lead manufacturing industry. The staff of the Association, however, have shown considerable enterprise in demonstrating the possible application of the alloys to pipe manufacture by carrying through in a works a full-scale experimental extrusion, themselves conducting the whole of the operations from the preparation of the alloys to the testing of the finished pipe. The manufacture of the pipe appears to offer no great difficulty and the products possess a greatly enhanced strength, thus indicating the possibility of producing pipe at least 30 per cent. less in weight than, and with a bursting pressure equal to, the present standard material.

It is hoped that some means can be adopted to investigate the possible industrial exploitation of these discoveries in this country, since otherwise there is a risk that they may be developed by foreign enterprise.

Material for Condenser Tubes

Prolonged researches on improving the quality of brass, apart from other successful applications, have led to the discovery of a new material for condenser tubes, which preliminary tests show to possess exceptional corrosion resistance properties. Active steps are being taken to secure trials of these tubes in the Navy, in the Mercantile Marine and in land installations. The dominating position of the condenser tube

in efficient steam power production is well known, and any improvement in its quality will have far-reaching effects.

The research work on both the lead alloys and the new material for condenser tubes was carried out for the Association in the Research Department, Woolwich. Both results have found immediate interest and adoption—or at least trial—in Government service, thus illustrating the close interdependence of industry and the State in work of this nature.

The Nickel Silver Group of Alloys

(From a Correspondent)

A LARGE group of alloys are covered by the term nickel silver. These alloys, which are composed essentially of copper, zinc and nickel, might be more accurately designated nickel brasses. They have been known and used for a considerable time, for alloys of this type—known as packfong—were brought to Europe from China as far back as the seventeenth century. In the nineteenth century they began to be developed commercially, chiefly as a cheap substitute for silver, their colour somewhat resembling that of the latter. This development began in Germany, and the alloys were soon introduced into France under the name of "Maillechort" (by which they are still widely known there to-day, after the first manufacturers Maillet and Chorier) and "Argent d'Allemagne." In England the product was known as German silver.

Production

Broadly, the alloys may be regarded as brasses to which additions of nickel have been made, resulting in a greater hardness and a white colour; the corrosion-resisting properties are generally superior to those of brasses. These properties have led to the extended use of the alloys for fittings for ships and motor cars, and as the basic metal for electroplated articles. They are silvery-white in colour, but the lower grades, that is those alloys containing about 10 or 12 per cent. nickel, have a yellowish tinge. The higher grade alloys compare with nickel in colour. The commercial alloys vary widely in composition, the nickel ranging from 5 to 35 per cent., copper from 45 to 65 per cent., and zinc from 15 to 35 per cent. The nickel content is the factor controlling quality and price.

While the alloys are susceptible to variations in casting temperature and the presence of impurities, such elements as tin, iron, manganese or lead are added to harden them or improve the machining qualities. Manganese in the form of copper-manganese alloy is frequently added to the molten metal before casting to deoxidise it, and acts beneficially in this way; the small amount of residual manganese left in the metal tends to improve its mechanical properties generally. Provided reasonable care is taken in the melting operation and in the preparation of the moulds, there are no special difficulties attached to the casting of nickel silver into either sand or chill moulds. The freezing point depends on the composition, and a satisfactory casting temperature cannot be given to cover the whole range of alloys, but it would seem that it is better, from the standpoint of quality of the product, to maintain casting temperatures on the high side rather than on the low. Generally the metal is melted in graphite crucibles, and the molten metal is usually protected from furnace gases by a layer of charcoal. Recently, nickel silvers have been successfully produced in electric furnaces.

Lead effects a great improvement in the machining properties of commercial nickel silvers, and on this account is frequently added in amounts from 1.5 to 2.5 per cent.; but it also has the effect of reducing the ductility and malleability. Iron hardens the alloys.

Uses

In the cast state, the commercial alloys show the familiar cored structure, which on annealing becomes homogeneous like that of 70/30 brass. In addition to being used for table ware and decorative fittings, the alloys, because of their suitable electrical properties, are used in the form of tape and wire as resistance materials. Practically all the alloys are capable of cold working to a great extent, and sheet, strip, wire, etc., are made in a wide range of compositions. In the early stages of rolling it is frequently necessary to be cautious if edge cracking is to be avoided. By careful alternate working and annealing, the original cast ingot structure is

broken down, after which the metal can be readily worked further. In fact, sheet sufficiently thin to be regarded as foil can be rolled. Until comparatively recently the nickel silvers were regarded as essentially cold working alloys, but it is now known that some of them at least can be fairly readily worked hot. Guillet recorded the fact that with a relatively high zinc content, alloys suitable for hot working could be produced, suitable compositions being 10 per cent. of nickel, 45 per cent. each of copper and zinc, and 12 per cent. of nickel, 42 per cent. of copper, and 46 per cent. of zinc. It is also possible to hot-roll to some extent at least, alloys containing 10 to 20 per cent. of nickel with a copper content in the neighbourhood of 60 per cent. There seems no doubt that some of the limitations hitherto experienced both in the cold and hot working of these alloys have been due to the presence of impurities.

Mechanical Properties

The mechanical properties of the alloys vary with the composition and also with their condition, that is whether they are in the cast state or hard-worked or annealed. The annealing temperatures also depend on the composition, the temperature being 370° C. for the alloy containing 7 per cent. of nickel and 600° C. for the 28 per cent. nickel alloy. According to Price and Davidson, the nickel silvers of low nickel content are in a general way slightly harder than brass when subjected to the same treatment. Alloys of higher nickel content, whilst somewhat harder in the annealed state, do not harden with severe cold rolling as rapidly as those of lower nickel content.

According to Thompson, alloys containing up to 20 per cent. of nickel, in the cast state, have a yield point of about 7 to 9 and a maximum stress of 15 to 18.5 tons per square inch, with elongations and reductions of area from 34 to 47 and 33 to 47 per cent. respectively. With more than 20 per cent. of nickel, the yield point and maximum stress can be raised to about 11 and 25 tons per square inch respectively, with values for elongation and reduction of area in the neighbourhood of 35 per cent. In the form of cold-rolled sheet, the yield point and maximum stress approximate to 50 tons per square inch, with a Brinell hardness of about 175. This was found to be the case, by Price and Davidson, for an alloy—of low grade—containing 65 per cent. of copper, 7 per cent. of nickel, and 28 per cent. of zinc. With an alloy of higher grade, 18 per cent. of nickel and 16 per cent. of zinc, hard-rolled sheet showed a maximum stress of 44 tons per square inch and Brinell hardness 173. On annealing, a very wide range of figures can be obtained, depending upon the amount of work done on the material and the extent to which the annealing is carried out. With the low grade alloy, it is readily possible to obtain a maximum stress of 25 tons per square inch with an elongation of 55 per cent. Results obtained by Thompson show that, for three alloys containing 10, 15 and 20 per cent. of nickel with 60 per cent. of copper, the maximum stress falls and the elongation increases as the annealing temperature is raised to 860° C., the actual values obtained after annealing at this temperature being 22.2, 25.5 and 26.3 tons per square inch maximum stress and 68.6, 48.6 and 45.4 per cent. elongation.

A large variety of copper-nickel-zinc alloys, many under trade names, are made in sand castings. Alloys such as "Aterite" and "Malloydium," which are resistant to certain acids and chemical liquids, are in this class. "Nickelene," "Victor Metal," and silver bronze are used in the form of castings for a variety of fittings. Many other alloys containing additional elements, notably lead and iron, find wide application in the form of castings.

M. C.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Institute of Metals: Coming-of-Age Meeting

THE twenty-first annual general meeting of the Institute of Metals will be held in the hall of the Institution of Mechanical Engineers, Storey's Gate, Westminster, London, on Wednesday and Thursday, March 13 and 14. Professor W. Rosenhain, F.R.S., has again been nominated for the presidency, and will be duly declared elected.

Papers

The following papers are expected to be submitted at the meeting: "Recent Developments in Electric Furnaces," by D. F. Campbell; "An Improved Form of Electric Resistance Furnace," by W. Rosenhain and W. E. Prytherch; "Note on the Testing of Electrodeposits on Aluminium," by G. B. Brook and G. H. Stott; "The Importance of Design and Setting of Large Kettles Used for Refining and Low Melting Point Alloys," by H. C. Lancaster; "Brittleness in Arsenical Copper—II," by C. Blazey; "Special Properties of Eutectics and Eutectoid Alloys in Binary Metallic Systems," by Professor P. Saldau; "Work-Softening and a Theory of Intercrystalline Cohesion," by F. Hargreaves and R. J. Hills; "The Age-Hardening of Some Aluminium Alloys," by Dr. Marie L. V. Gayler; "The Constitution of the Cadmium Rich Alloys of the System Cadmium-Gold," by P. J. Durrant; "The System Magnesium-Zinc," by W. Hume-Rothery; "Alloys of Zirconium—II," by C. Sykes; "The Resistance of Zinc to Indentation (A Preliminary Account)," by J. N. Friend; "The Solution of Plain and Amalgamated Zincs in Electric Batteries," by J. N. Friend; "The Silver Contents of Specimens of Ancient and Mediaeval Lead," by J. N. Friend and W. E. Thorneycroft; and "A Note on the Haughton-Hanson Thermostat. A Method of Fine Adjustment," by P. J. Durrant.

Conversazione and Annual Dinner

THE annual dinner of the Institute (at which Lord Melchett will be one of the speakers) will be held at the Trocadero Restaurant, Piccadilly Circus, London, on Wednesday, March 13, at 6.45 p.m. for 7 p.m. The dinner will be followed by a dance, which will conclude at midnight. By the courtesy of the Director of the Science Museum, a conversazione to celebrate the "coming of age" of the Institute will be held in the Science Museum, Exhibition Road, South Kensington, London, in the evening of Thursday, March 14.

The President (Dr. W. Rosenhain, F.R.S.) and Mrs. Rosenhain will receive members and friends at 8 p.m. In addition to the many interesting objects normally on view in the Science Museum, there will be special exhibits of metallurgical interest, arranged by the Institute. Members who are able to offer for exhibition on this occasion objects of metallurgical interest in relation to the work and objects of the Institute are invited to communicate with the secretary, as soon as possible. Admission to the conversazione will be by ticket, obtainable from the secretary; each member may obtain one ticket in addition to his own. Light refreshment will be provided.

The annual autumn meeting will be held in Düsseldorf, Germany, in September, the date of the meeting being September 9 to 12 (provisional). As this is the first meeting of the Institute to be held in Germany, it is hoped that there will be a good response to the warm invitation that has been received from the Verein Deutscher Ingenieure and Deutsche Gesellschaft für Metallkunde, which societies will be the Institute's hosts on the occasion of the forthcoming meeting, details of which will be announced later.

Thanks to the courtesy of the British Industries Fair management committee, members of the Institute (to a total not exceeding 200) are invited to visit the British Industries Fair, Birmingham, on February 21, and to partake of luncheon at the Fair. Reduced fare railway vouchers will be available.

The Electron and Its Censors

PROFESSOR EDDINGTON is by no means alone in feeling dissatisfaction towards the electron theory in some of its modern aspects and implications. A new theory altogether seems to

be called for, in spite of the ingenious interpolation of various constants into equations based on electron theories, in order to preserve the latter at any cost—even that of quite unjustifiable assumptions. As Professor Millikan has said: "We use the wave theory where it works, and the quantum theory where it works, and try to bridge the gap between the two apparently contradictory theories in purely formal fashion by what we call the correspondence principle." This is a statement of the milder sort, and is qualified by the use of the phrase "apparently contradictory theories." Bohr devised a theory and a model with a view to reconciling the four main discrepancies in classical electrodynamics and competing theories, feeling, as he says in his book, that the collapse of the former might well make one feel that physics "had suddenly become homeless," but his theory is of the nature of an expedient, and sooner or later a breakdown seems inevitable. The question is a serious one, for if, as Professor Eddington says, the electron is but a dummy, many ultimate problems in electrochemistry and even in metallurgy will require to be thoroughly overhauled and re-established on safer foundations, and these do not seem even to have been laid as yet. In the meantime, the accumulation of disconnected data derived from research work on problems of an immediately practical nature (such, for instance, as the structure of metals and alloys, the physics of electro-deposition, and even surface tension phenomena) becomes so large and complex that it will almost transcend human ability to piece all the facts into one coherent and fundamental theory of the constitution of matter.

Non-Ferrous Metallurgy in Great Britain

DR. WILLIAM CULLEN raised some very pertinent questions at the meeting of the Institution of Mining and Metallurgy on January 17, when he read a paper on the possibilities of reviving non-ferrous metallurgy in Great Britain. It is true that except for tin, we have but meagre resources for most of the base metals, but if Great Britain's former mineral wealth has been depleted there is ample in our colonies to build up, once again, at least a respectable copper and lead industry. Dr. Cullen foresees that electrical developments, present and prospective, should enable a much-neglected branch of non-ferrous metallurgy to be undertaken at home with profit to ourselves, in that much Empire copper could be treated electrolytically at home.

It is probably too late to contemplate any revival on a really large scale. The Dominions and Dependencies, rich in copper, have their own hydroelectric resources, and have emerged from the tutelage of the mother country. At the same time, it is evident that a great deal could be done, seeing that far too much African copper from British possessions already goes to America for refining. Moreover, Germany finds it to her interest to import and refine very large amounts of foreign material, and if it pays to do so in that country it should surely pay to do so in our own. The recovery of precious metals from electrolytic slimes is a profitable business, and with the will to carry out such operations at home Great Britain might easily recover at least part of a trade in which other nations bid fair to leave her far behind. The Institution of Mining and Metallurgy and the Empire Council of Metallurgical Associations to which it gave birth, are plainly the bodies to promote any movement of the kind, as their membership comprises both technical and commercial interests. It is to be hoped that something will come of it, but, as Dr. Cullen says, vested interests are strong, and the task bristles with difficulties. It is disconcerting, however, to find that our country is falling back in the race in this, as in other metal industries, and—notably—in the heavy iron and steel trades.

Accelerated Corrosion Tests

THE mere mention of accelerated corrosion tests suffices to evoke an outburst of wrath in many otherwise eminently reasonable folk, and it may freely be admitted that in the past there have been good reasons for this. Many published results have been based on superficial observations, but if the function of such tests is rigorously defined and limited, the results may be exceedingly useful. An accelerated corrosion

test cannot be made to apply specifically to a single metal, exposed by itself, to the vagaries of "simulated" atmospheric or other agencies, and any attempt to do so is bound to lead to ill-established conclusions as to behaviour, which are by no means applicable in real and practical conditions. As a means of testing comparatively the behaviour of two or more metals, exposed simultaneously and under identical conditions to, say, spraying, either continuous or intermittent, by some specific solution, an accelerated corrosion test may yield useful information as to the relative resistances of the metals so subjected. More than this it would be unwise to claim, but this much is by now generally conceded even by those opposed to an indiscriminate extension of the principles involved.

Bureau of Standards Method for Zinc Coatings

THE BUREAU OF STANDARDS has experimented with a process which, employed with reasonable care, promises useful indications as to how galvanised zinc coatings will behave in practice. The investigation, carried out by Messrs. Groesbeck and Tucker, had as its object the comparison of the merits of ordinary "simulated atmospheric corrosion tests, and spray tests, as currently applied by other investigators as part of the ordinary industrial routine for estimating the 'life' of the zinc coating of hot galvanised materials." A concentrated moist acidic atmosphere similar to that prevalent in industrial centres and in some large cities was employed in one set of experiments, and in the second the specimens were subjected to normal solutions of sodium chloride and ammonium chloride, used separately, in the form of a fog, or mist. Each specimen had the changes of these sets of conditions rung on it in cycles of regular periods, and in the result a consistent relationship was found between the number of cycles the zinc-coated specimens withstood and the thickness of the coating. Incidentally, the presence of up to 0.2 per cent. of copper in the steel base metal produced no observable effect on the life of the coatings. The whole research is convincingly described, and yet somehow fails to convince. The consistent relation is so seldom found in any such tests that a little scepticism is perhaps pardonable. In practice—and the results of accelerated tests carried out in laboratories notwithstanding—it is the unexpected that happens, and zinc-coated metals that have stood up gaily to all sorts of untoward treatment, fail, often in the most mystifying manner, when subjected to the milder exigencies of everyday life.

International Association for Testing Materials

A MEMORANDUM has recently been issued by the New International Association for Testing Materials (N.I.A.T.M.) concerning the present position and activities of the Association, and some recent decisions arrived at by the permanent committee of the Association held in Paris on June 21 last. The main object of the Association is to hold periodical congresses, but experience has shown that it is not satisfactory at a single congress to discuss subjects concerning the whole range of the testing of materials. It has, therefore, been decided to confine attention at each congress to a relatively small number of specially important subjects in each of the sections. On the other hand, undue specialisation in international discussions is to be avoided.

To solve the task of selecting subjects for the next congress, to be held in Zurich in 1931, all participating countries were asked to forward suggestions. Sixteen countries have responded, and the outcome of their suggestions is an invitation to each country to prepare a number of preliminary summary reports on a small number of selected subjects and to appoint reporters. It is proposed to publish these preliminary reports early in 1930, in either English, French or German. When the permanent committee receives these preliminary reports it will be in a better position to consider the final selection of subjects for the congress of 1931. The British Committee, the offices of which are at 28, Victoria Street, London, S.W.1, is taking steps to secure widespread membership among those interested in the testing of materials, and it is anticipated that Great Britain will be adequately represented when the reports are published by the International Association.

Thermal Expansion of Magnesium

THE latest investigations as to the thermal expansion of magnesium, a coefficient of increasing importance in view of

the possibilities of the use of the metal and its alloys in aeroplane engines, have been carried out, with the meticulous care which invariably characterises all its work, by the Bureau of Standards, Washington. The results are embodied in Research Paper No. 29. The following average equation is given as representing the expansion of magnesium between 20° and 500° C:—

$$L_t = L_o [1 + (24.80t + 0.00961t^2) 10^{-6}]$$

It was observed that both in the case of extruded magnesium and its extruded alloys, the coefficients of expansion were slightly lower than in the case of the last materials. The experiments on magnesium itself were carried out at ranges varying from -183° to 500° C. As the metal oxidises in air at about 550° C., the upper limit was as high as was deemed advisable, while the lower limit is, of course, as low as is ever likely to be attained in any conceivable application. Within a 20–300° C. range, the expansion of aluminium-magnesium alloys containing from 4.44 to 10.35 per cent. of aluminium is practically the same as that of the aluminium-copper alloys containing similar percentages of copper. When manganese is added to magnesium-aluminium alloys, the coefficients of expansion increase with increasing temperature.

Control of Acidity in Nickel Plating

THE considerable amount of research which has been carried out on electro-deposition during the past ten years has emphasised the importance of accurate control of all phases of the electro-plating operation. In particular, attention has repeatedly been drawn to the necessity for close regulation of the acidity of the bath. Failure to keep this within suitable limits has been the unsuspected cause of many plating troubles. It is of interest, therefore, that a pamphlet entitled "The Control of Acidity in Nickel-Plating Solutions," by Mr. A. W. Hotherhall, has been issued by the Research and Development Department of the Mond Nickel Co., Ltd. (which, by the way, now has the following address: Imperial Chemical House, Millbank, London, S.W.1). In this pamphlet, Mr. Hotherhall discusses the meaning of "pH"; the importance of pH control; the measurement of pH in electro-plating solutions (electrometric and colorimetric methods); the control of pH in plating baths; the importance of buffer action in plating solutions; and the preparation of standard buffer and indicator solutions.

The importance of a knowledge on the part of the operator of the pH conditions of his plating baths is emphasised, and, in view of the delicate and costly apparatus required for electrometric methods of pH determination, a good deal of space is devoted to colorimetric methods. It is pointed out that these are sufficiently accurate for control purposes, may be carried out with inexpensive apparatus, and do not involve highly skilled technique.

Reported Discovery of Tin in Manitoba

THE Industrial Development Board at Winnipeg states that considerable interest is being taken in a tin strike made at Chatford Lake, between the Oiseau and Winnipeg Rivers in eastern Manitoba. The Manitoba Basin Mines, Ltd., have secured 15 claims covering about 3 miles on the vein strike, and it is reported that samples from this strike have yielded from 21 to 33 per cent. of tin oxide. A number of prospectors have gone into the district from the Kirkland Lake district of Ontario. The *Financial Post* (Toronto), in commenting on the reported discovery of tin in the Lac du Bonnet district of Manitoba, about 100 miles from Winnipeg, states that it is in lode form and that a large number of samples have been sent to Toronto, Montreal and New York for assay. Little has been made known about the discovery as yet, as it is understood that engineers are busy trying to work out the geology before launching into an exploratory effort. Considerable surface stripping and trenching has been done, however, and some massive ore opened up. Samples of massive ore composed of mica and sphalerite embedded in quartz are now in Toronto, and further parcels are being sent in order to enable the assayers to make large-scale tests. The high values secured in the majority of the samples sent for assay make the reports as to the Manitoba discovery important, should they be confirmed. Tin is the one important metal which Canada has never yet produced on a commercial scale.

Trade, Commerce, Finance: The Month in Review

From Our Market Correspondent

SINCE the opening of the New Year the market has been quite steady, and has retained the feeling of confidence which was noticeable in the closing weeks of the old year. Most of the works were able to make a good start with the orders which had accumulated during the holidays, and there has been a fair amount of buying during the month. This is a time when a number of contracts fall due for renewal, and buyers have shown an inclination to cover themselves well forward. While this does not necessarily mean a great increase in specifications, there are probably more orders on the books now than for some time past, and makers can see at least a few weeks' full work ahead. The better demand from the shipbuilding yards and constructional engineers, and the contraction in the amount of business placed on the Continent, have contributed to the revival of a spirit of optimism. That is very welcome, and if it lasts for a month or two, all will be grateful.

Optimistic Feeling

In some quarters there is a belief that this movement is not merely a spasm, but is likely to endure. One can only pray that it may be so, but—and unfortunately the "buts" and "ifs" loom too large in this industry—one would like to see a more substantial basis on which to build. There are bound to be rises and falls even in the state of trade to which we have been accustomed for so long a period, and without wishing to act as a wet blanket one is bound to admit that the present movement is most likely nothing more than one of these periodical "ups," to be followed before long by the inevitable "down."

The actual position of the steel industry as a whole is surely now so well known and clearly recognised that it is unnecessary again to explain it or to point out once more that it is useless to expect any lasting revival, which shall bring in again the years of prosperity, until some very drastic change takes place either within the industry itself or in the outside forces which to a large extent determine its real condition. To the plain question, is such a change in sight, there is bound to be a negative answer, although there are signs that the leaders of the industry are beginning to move along lines which they consider show the only way to salvation. For some time to come one must look forward to a period of part time activity with occasional bright intervals.

Associations and Prices

We are now apparently passing through one of these brighter periods, but its real worth may be judged by the manner in which the steel makers are responding to it. In last month's report, reference was made to the approaching meeting of the steel associations and to the possibility of some slight advance in price to meet the increased cost of production. That meeting has been held, and the outcome of the deliberations of the steel makers is that no change is to be made at present. The official prices which have now been in force nearly a year are to continue, notwithstanding the higher cost of manufacture. It may well be that the steel makers regard the present movement as being not firmly enough established to warrant an increase in price, which might have the effect of putting a quick end to it.

In any case they do not feel their position to be strong enough to enable them to bring their selling prices into such a relation to costs that they will be no worse off than they were, say, six months ago. Whatever extra burden is imposed by the price of fuel and scrap is to be borne entirely by the steel makers, and to that extent the industry is in a worse position notwithstanding the cheerful tone of the market.

Uncontrolled Materials

That is the position so far as the controlled materials are concerned. What about the uncontrolled materials? Take boiler plates as an example. The attempt to establish a reasonable price for this class of steel appears to be hung up, as no definite decision has yet been made, and in the meantime makers are readily taking orders at the old price. The small bar trade is another example. Several of the makers have striven hard to bring the price up to a reasonable level,

and it only needed a general agreement on this point to effect this necessary change; but their efforts have been frustrated by the action of a certain section of the steel makers who, in their anxiety to gain an advantage over the other makers, have established for a further period the ridiculously low prices which have been in force for some time past.

It is correct to say that in this way a definite loss has been suffered by this section of the trade, which could have been avoided if there were more co-operation. Steel sheets below $\frac{1}{16}$ in. thick, which are also outside the scope of the associations, are being sold at the old prices, and there is no hesitation on the part of some makers to shade the price a little in order to secure business over the heads of other makers.

The railway companies have now fixed up their contracts for the current year's supplies, and prices generally are the same as those in force last year, with reductions in one or two instances.

Rationalisation

It will thus be seen that the actual evidence does not justify any fond hopes of a material improvement in the steel trade with its present resources and under existing conditions of operation. It is not surprising, therefore, that more and more attention is being given to the policy of rationalisation, which is now considered by most authorities to be the only solution to the problems by which the industry is confronted. Particulars have already been given of the arrangement entered into by Vickers, Cammell Lairds, and Armstrongs, Dorman Long and Co. and Bolckow Vaughan, who are the two largest steel makers on the North-East coast, are entering into a similar arrangement, whereby their resources will be pooled and their activities will be so directed that the most economical production can be attained by the concentration of the work in the most efficient units. In this way, both production and distribution will be effected at the lowest possible cost.

Such a process of reorganisation is most desirable and necessary throughout the industry, and it will ultimately have to be carried out.

Pig Iron

Although there is no change to report in the finished steel trade, there are certain improvements noticeable in the pig iron market. The foundry iron makers are firmly resisting any further reductions in price, and in some instances they are insisting on an advance. They are compelled to do so by the cost of manufacture, and it will not be surprising if all the makers follow suit. Basic iron is definitely firmer, and the price is moving upwards. Hematite is also stronger, and higher prices are being asked for forward contracts. Makers are not at all anxious to take orders at the old prices, as the demand has now overtaken the supply, and stocks have been practically cleared out.

There is no relief in the price of fuel and scrap. The coke position is a little easier, as the demand for export has fallen off, and consequently there is more coke available for the home trade. The price remains firm. Scrap is still moving upwards, and has not yet reached the top. The combined effect of these movements may yet force the steel makers to put up their prices, but it would not be safe to prophesy.

Continental Steel

There has been a lull in the buying of Continental steel. Prices are firm, and delivery still uncertain, with the result that there is little advantage in sending the orders abroad. This applies particularly to semi-finished steel. This position is not likely to continue indefinitely; in fact there are indications that a fresh bid will be made for the English market, and already a very large quantity of slabs and billets is being offered over here at attractive prices.

The output of pig iron during the month of December was 540,400 tons, compared with 544,400 tons in November, the number of furnaces in blast at the end of the month being three less than at the beginning. The output of steel was 683,100 tons, compared with 762,500 tons in November, the difference being chiefly due to the Christmas holidays.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature, published weekly in THE CHEMICAL AGE.

Alloys

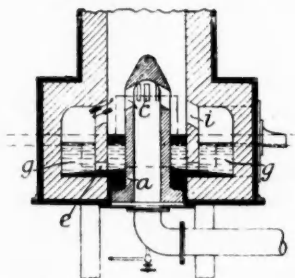
VARIOUS nickel-iron-chromium alloys are described in a series of three Patent Applications, 300,248-50, bearing the International Convention date November 10, 1927, by Barber Asphalt Co. of Philadelphia, U.S.A.

According to Application 300,248 the alloys contain nickel (20-40 per cent.), iron (30-50 per cent.), chromium (15 to 25 per cent.), silicon (up to 1 per cent.), and manganese (up to 2 per cent.) with or without tungsten, cobalt, and copper, the total amount of the last five elements being not more than 10 per cent. According to Application 300,249 the alloys contain nickel (15-25 per cent.), iron (50-60 per cent.), chromium (10-20 per cent.), and a total amount not exceeding 10 per cent. of one or more of the additional five elements. According to Application 300,250 the alloys contain nickel (50-60 per cent.), iron (20-25 per cent.), chromium (10-20 per cent.), and a total amount not exceeding 10 per cent. of one or more of the additional five elements.

ALLOYS of lead with one or more of the alkali or alkaline earth metals are made homogeneous by extrusion, according to Patent Application 300,129, bearing the International Convention date November 5, 1927, by I.G. Farbenindustrie Akt.-Ges., of Frankfort-on-Main, Germany. The effect is improved if the alloy is caused to pass, within the press, through a perforated plate. The extruded material may be in any desired solid or tubular form. A lead alloy containing 20 per cent. of sodium with or without 0.4 per cent. of barium is referred to.

Cupola Furnaces

THE lower end of the shaft of a cupola furnace (see figure herewith) is provided with an annular chamber *g* which communicates with the main shaft through upper and lower openings *i*, *e*, and constitutes a refining chamber for the molten metal. A central tuyère *a* delivers air through radial



300,559

downwardly-inclined ports *c* at a higher level than the openings *i*, and holds up the solid part of the charge to prevent its obstructing the openings *i* and the ports *c*. Jets from a liquid fuel burner are directed through the ports *c* and the openings *i* into the refining chamber *g*. See Patent Application 300,559, bearing the International Convention date November 14, 1927, by P. Marx, of Hennef-on-Sieg, Germany.

Electrolytic Processes

To obtain smooth and dense deposits of metals such as copper or zinc, a hydrophilic inorganic colloid, insoluble in the electrolyte, is added to the bath. The colloid must enter the cell in the required state of dispersion, and must be free from detrimental impurities. For the electrolysis of a solution obtained by leaching zinc oxide, free from silica, with acid zinc sulphate solution, colloidal silicic acid may be added. For refining copper the colloidal addition may be a hydrated tungstic acid. Metatitanic and zirconic acids are suggested as suitable for addition to acid electrolytes, and ferric and magnesium hydroxides as suitable for addition to alkaline electrolytes. See Patent Application 299,725, bearing the International Convention date October 27, 1927, by Metallges Akt.-Ges. (formerly Metallbank und Metallurgische Ges.), of Frankfort-on-Main, Germany.

Extraction of Metals

THE recovery of metals, such as silver, copper, zinc, nickel, or cobalt, having compounds which are soluble in ammoniacal liquors, is effected by subjecting the materials to a chlorination treatment at an elevated temperature, and then leaching the solid material, free from uncombined metals, with a solution of ammonia or an ammonium salt or both. Such leaching is preferably preceded by a leaching with warm water, whereupon the chlorinating agent is recovered from the aqueous solution for use again. If base metals are present in a low form of oxidation, the chlorination should be followed by a short oxidation treatment. The procedures adopted for recovering the five metals above referred to from various types of copper schists are described in examples. See Specification 301,342 (Johnson), dated August 24, 1927, a communication from I.G. Farbenindustrie Akt.-Ges., of Frankfort-on-Main, Germany.

Reduction of Ores

ACCORDING to Patent Application 301,011, bearing the International Convention date November 23, 1927, by M. Lambot, of Brussels, iron and other ores are reduced by feeding the ore in admixture with a solid reducing agent such as coal through a heated rotary cylinder, and delivering the reduced ore together with the unused reducing agent into a chamber in which the required degree of carbonisation of the metal is effected. The carbonised metal is then fused in a furnace for removal of the impurities as a slag. Provision is made for the economical utilisation of the gases from the reduction and fusion furnaces, and for the recovery of by-products.

THE raw material used in the reduction of oxides or oxide ores in an electric furnace to obtain metals or alloys is so constituted, by reason of selection, preparation, or addition thereto of slag-forming material, that there is produced as a valuable by-product a highly-refractory slag containing less than 15 per cent. of silicic acid and consisting otherwise mainly of magnesia and alumina. Thus, in the production of iron or iron alloys from iron ores, magnesite or bauxite or both may be added to the charge; and in the production of ferro-chromium or other chromium alloys, the charge may be constituted so that the slag contains up to 35 per cent. of chromium oxide, less than 15 per cent. of silica, and less than 5 per cent. of iron oxides. See Patent Specification 302,087, dated February 18, 1928, by T. R. Haglund, of Stockholm, Sweden.

Steel

THE elongation limit and tensile strength of low-carbon steel are increased by quenching from a temperature below the range of decomposition of austenite, and thereafter storing or heating to a temperature not above 250° C. The steel may contain small amounts of chromium, nickel, silicon, molybdenum, etc. See Patent Application 300,553, bearing the International Convention date November 14, 1927, by Vereinigte Stahlwerke Akt.-Ges., of Düsseldorf, Germany.

Zinc

ACCORDING to Specification 300,519 (Mellersh-Jackson), dated August 8, 1927, a communication from the New Jersey Zinc Co., of New York, the heating of a porous charge of agglomerates of zinciferous material and reducing agent to a temperature sufficiently high to reduce the zinc compounds and to volatilise the resulting zinc is effected by passing the charge through a horizontal externally heated chamber under such conditions as to avoid relative movement of individual agglomerates and without any substantial breaking down of the agglomerates. The charge is preferably carried upon a layer of coarse material which in turn rests on a bed of fines carried by a conveyor moving horizontally through the chamber.

ZINC oxide and ores containing it are reduced by heating at 800-900° C. under reduced pressure with copper, manganese, or iron in the absence of carbon or other materials yielding gaseous reaction products. Iron may be used in such amount as to form ferroso-ferric oxide, which may then be reduced to iron for use again. See Patent Application 298,636, bearing the International Convention date October 13, 1927, by Metall-Ges. Akt.-Ges. (formerly Metallbank und Metallurgische Ges. Akt.-Ges.), of Frankfort-on-Main, Germany.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALUMINIUM.—Methods proposed, and in use for, refining aluminium ores. C. L. Mantell. *Chem. and Met. Eng.*, December, 1928, pp. 746-750.

CASE-HARDENING.—Depth and character of case induced by mixtures of ferro-alloys with carburising compounds. E. G. Mahin and R. C. Spencer. *Trans. Amer. Soc. Steel Treating*, January, pp. 117-144. If silicon absorption is confined to surface layers of iron or steel, carbon absorption during case carburisation may be retarded without materially affecting the rate of inward migration of the carbon after it has been absorbed. By using this principle it has been found possible to produce a deep case without a zone of free cementite, by means of an ordinary carburiser in conjunction with ferrosilicon and by employing higher carburising temperatures.

CORROSION.—The influence of nitrogen on the solubility of ferrous materials in hydrochloric acid. II.—The effect of the carbon content. III.—Further experiments. H. H. Gray and M. B. Thompson. *J. S. C. I.*, January 25, pp. 21-25, 25-28.

Corrosion. A round-table discussion. R. J. McKay. *Ind. Eng. Chem.*, January, pp. 35-37.

Protection of underground pipe from corrosion. A method used in South California. E. O. Slater. *Ind. Eng. Chem.*, January, pp. 19-21.

Effects of additions of lime and soda ash to brackish water on the corrosion of iron and steel. H. O. Forrest, J. K. Roberts, and B. E. Roetheli. *Ind. Eng. Chem.*, January, pp. 33-35. Additions of lime to waters high in bicarbonate and calcium content will cause the formation of protective calcium carbonate scales on steel or iron structures. Waters containing appreciable quantities of magnesium salts require soda ash as well as lime treatment to increase the pH and supply carbonate ions before a calcium carbonate scale can be built up. A pH of 8.5 or higher is favourable to the formation of protective carbonate scales.

ELECTRODEPOSITION.—The action of various electrolytes on the electrodeposition of copper. A. Juliard and J. Ledrut. *Bulletin Société Chimique Belgique*, November, 1928, pp. 377-384 (in French).

GENERAL.—Changes occurring in the rolling, hammering, and drawing of zinc and cadmium. G. Masing. *Zeitschrift Metallkunde*, December, 1928, pp. 425-427 (in German). On the extension of zinc and cadmium by rolling, etc., the coefficient of expansion, contrary to expectations, at first rises very strongly, and twinning occurs in a marked degree. In the further course of rolling, there occurs in these metals, in addition to translation, another phenomenon, apparently twinning.

Changes in length and in the modulus of elasticity of beryllium-copper alloys on annealing. O. Dahl and C. Haase. *Zeitschrift Metallkunde*, December, 1928, pp. 433-436 (in German).

The system tungsten-carbon. K. Becker. *Zeitschrift Metallkunde*, December, 1928, pp. 437-441 (in German). A metallographic and X-ray investigation.

IRON.—The influence of nickel on combined carbon in gray iron. J. R. Houston. *Trans. Amer. Soc. Steel Treating*, January, pp. 145-157, 169.

MOLYBDENUM.—Recent work on molybdenum and its application. H. Alterthum. *Zeitschrift angewandte Chem.*, January 5, pp. 2-11 (in German).

NICKEL.—The dependence of the falling hardness of nickel on the temperature. F. Sauerwald. *Zeitschrift für Metallkunde*, November, pp. 408-409 (in German).

SOLDER.—Lead-tin-cadmium as a substitute for lead-tin wiping solder. E. E. Schumacher and E. J. Basch. *Ind. Eng. Chem.*, January, pp. 16-19. The addition of cadmium makes possible the use of higher percentages of lead in satisfactory solders. These lead-tin-cadmium wiping solders are generally cheaper than corresponding lead-tin solders. A solder containing 68 per cent. lead, 23 per cent. tin, and 9 per cent. cadmium is satisfactory as a substitute for standard 62 per cent. lead-38 per cent. tin solder.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ALUMINIUM CORPORATION, LTD., London, S.W.—Registered December 31, £13,800 C debentures, part of £500,000; general charge. *£1,293,506. July 10, 1928.

COX AND DANKS, LTD., London, W., metal merchants.—Registered December 12, £30,000 charge (payable as to £15,000 on execution of deed and instalments of £3,000 each on January 1, February 1, March 1, April 1 and May 1, 1929), to Alloa Shipbreaking Co., Ltd., 125, Buchanan Street, Glasgow; charged on all the property and assets of the company now or at any time during the continuance of this security being at Scapa Flow, and in and about the Orkney Islands. *Nil. November 23, 1928.

DUNDERLAND IRON ORE CO., LTD., London, E.C.—Registered January 3, Trust Deed dated December 28, 1928, securing £100,000, in addition to £100,000 secured by Trust Deed dated February 25, 1925; charged on property comprised in principal Trust Deed. *£162,916. December 6, 1927.

PARTINGTON STEEL AND IRON CO., LTD., Irlam.—Registered December 18, Trust Deed securing £1,000,000 income debentures; charged on properties comprised in schedule to the filed particulars, also general charge. £1,471,325. October 13, 1927.

PEARSON AND KNOWLES COAL AND IRON CO., LTD., Warrington.—Registered December 18, Trust Deed dated December 13, 1928, securing £500,000 serial income notes; charged on properties comprised in schedule to filed particulars, also general charge (subject, etc.). *£1,820,000. October 13, 1927.

TEJA MALAYA TIN DREDGING CO., LTD.—Registered December 27, Trust Deed dated December 21, 1928, securing £100,000 and premium of 5 per cent.; charged on lands, tenements, real and immovable property of company present and future, etc. *Nil. July 9, 1928.

Satisfactions

MALAYAN TIN DREDGING, LTD., London, E.C.—Satisfaction registered December 14, £100,000, registered July 30, 1924.

PARTINGTON STEEL AND IRON CO., LTD., Irlam.—Satisfaction registered December 22, £1,500,000, registered May 6, 1924, March 16, 1927, March 30, 1928, and April 4, 1928.

PEARSON AND KNOWLES COAL AND IRON CO., LTD., Warrington.—Satisfaction registered December 27, £25,000, registered October 30, 1928.

ROWHEDGE IRONWORKS CO., LTD.—Satisfactions registered December 20, £1,000 registered November 8, 1905, £500 registered November 8, 1906; £500 registered November 11, 1907 and £1,000 registered November 27, 1909.

London Gazette, &c.

Company Winding Up Voluntarily

ILORIN (NIGERIA) TIN FIELDS, LTD.—At an extraordinary general meeting of the above named company, held at Finsbury Pavement House, London, E.C.2, on Tuesday, January 1, the following Special Resolution was passed; and at a subsequent extraordinary general meeting held at the same place on Wednesday, January 16, the following Special Resolution was duly confirmed:—(1) "That the company be wound up voluntarily, and that Leonard Candy Walker, Incorporated Accountant, of Finsbury Pavement House, London, E.C.2, be and is hereby appointed liquidator for the purposes of such winding up."

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our *Monthly Metallurgical Section* should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Electrodeposition of Cadmium for Rust Prevention.—(I)

A Paper read before the Electroplaters' Society

A very instructive paper on the subject of cadmium plating, under the above title, was read before the Electroplaters' and Depositors' Technical Society by Mr. S. Wernick, M.Sc., hon. secretary of the Society, at the February meeting. The paper was well illustrated by numerous charts, lantern slides, and specimens of cadmium and cadmium-nickel platings after subjection to corrosion and mechanical tests.

MR. WERNICK said that one of the most important of the recent developments in the plating industry was the advent of cadmium plating for use primarily as a rust preventive for ferrous material. Its increasing application indicated that the deposit was generally considered to fulfil this function satisfactorily. The literature, however, showed that there had been marked divergence of opinion as to the efficiency of cadmium as a rust preventive, particularly as compared with zinc. Cadmium deposits might, however, differ widely in their physical properties, which largely affected their protective capacity, and it was probable that statements which were apparently contradictory might often have been rendered compatible were such details of the platings as the composition of the solution used, conditions of deposition, and thickness of the deposit, indicated in each case.

Assuming that such conditions as the use of reasonably homogeneous, non-porous base metal, effective preparation of the material before plating, etc., are postulated, then the protective capacity of the resultant plating would depend largely upon the fineness of the deposit (which was intimately bound up with the composition of the solution, and the electrical, mechanical, and thermal conditions employed in plating), the amount of cadmium deposited per unit area (*i.e.*, the thickness of the deposit), and the distribution of the deposit over the cathode area (which depended largely on the throwing power of the solution).

Composition of Solutions

A very wide divergence existed in the composition of cadmium-plating solutions recommended by different authorities, and there could be little doubt that these must be productive of deposits possessing fundamentally different characteristics. Each ingredient in the plating solution (as would be shown) had a greater or less effect, both on the type of deposit produced and the ultimate composition of the bath. In regard to the latter, most cadmium solutions had an inherent tendency to alter in composition, tending with few exceptions to "build up" in metal content and reduce in free cyanide concentration, so that there was, in addition, a progressive variation in the characteristics of the deposit as the solution aged. Apart from this, the inconvenience and cost of managing such a solution was an important item to the plater.

Consequently, one of the most desirable features in cadmium plating was the development of a solution, the tendency of which to vary in composition was at a minimum. Such a solution would be most amenable to control, and would be most likely to produce a standard and efficient type of deposit.

Electrode Efficiency Ratio

The ideal stabilised plating cadmium solution was one in which the anode and cathode current efficiencies were each 100 per cent. In such a solution the ratio of anode to cathode efficiency, or the electrode efficiency ratio, was unity. Like the majority of cyanide solutions, the anode efficiency of the average cadmium solution exceeded the cathode efficiency to a very appreciable extent. This excess might be as high as 25 per cent.—*i.e.*, the electrode efficiency ratio might reach 1.25. This might be decreased by using insoluble anodes,

as well as cadmium anodes, in the same solution. The effect of decreasing the effective cadmium area upon the electrode efficiency ratio is shown below in the case of one solution, the area of anode and cathode being identical:—

PER CENT. INSOLUBLE ANODE AREA.	ELECTRODE EFFICIENCY RATIO.
0	1.21
50	1.07
75	1.04

The effect was due to a reduction in the overall anode current density, although this reduction was by no means in proportion to the ratio of soluble anode area. This method of stabilising the cadmium solution was widely used; it appeared to be fairly effective, though it was not ideal. In practice, there was a progressive change in the ratio soluble/insoluble anode area owing to the gradual solution of the cadmium. The material usually used as the "insoluble" anode was steel, but to a small extent it was soluble, and introduced an undesirable ingredient into the solution. It had also been stated that it caused the decomposition of the ingredients in the solution, although others attributed a beneficial effect, suggesting that the tendency to build up carbonate in solution was lessened.

Variations in the Composition of the Solution

It might be anticipated from theory that the rate of solution and deposition of cadmium metal was likely to be affected by the concentration of the metal, the free cyanide, and the caustic alkali present, and a study of the effect of the concentration of the principal constituents in the solution upon the electrode efficiency ratio, undertaken by the author, yielded the results outlined below. An important property of the solution, which affected the economy of the cadmium-plating process, was its conductance, and measurements of the latter were made concurrently, so that the effect of an increasing concentration of the essential ingredients upon the conductance of the solution was obtained at the same time. Finally, the effect upon the appearance and fineness (grain size) of the deposit was also noted.

Effect of Increasing Cadmium Content

The cadmium content favoured by different writers varied from about 5 grams to over 30 grams per litre. Satisfactory deposits were obtainable at the lower concentrations, and, no doubt, considerations of economy in the case of such an expensive metal as cadmium had often led to their adoption in preference to solutions of higher cadmium content. As expected, however, it was found that progressive decrease in the electrode efficiency ratio occurred with increase in cadmium content, this being appreciable, even by doubling the lower limit quoted above, *i.e.*, when equal to 16 grams, and approaching unity at about 30 grams cadmium per litre. At the same time, there was a marked rise in the conductivity of the solution, amounting to almost twice its original value at this figure. Deposits having a very fine crystal structure—"structureless" to the naked eye—were obtainable with a cadmium content in excess of 30 gm./l. Owing to deficiency in free cyanide, "fouling" of the anode occurred with solutions of low cadmium concentration, but this occurred to a

decreasing extent with increase in the cadmium content, the anode remaining clean (except for a natural darkening) when the cadmium content reached 25 gm./l. and over.

Effect of Increasing Free Cyanide

Free cyanide was another constituent which varied widely in concentration in different formulæ for cadmium-plating solutions. From 6 to 60 grams per litre had been recommended. This constituent was stated to have a very pronounced effect on the solution of the anode, but using a solution having a cadmium content of approximately 30 gm./l., upon which figure the free cyanide was calculated as percentage (not as per cent. present in solution), increasing free cyanide content was found to increase only very slightly the electrode efficiency ratio, even when the concentration of free cyanide reached 125 per cent. At higher concentrations, however, there was a marked increase in the electrode efficiency ratio. Free cyanide might therefore vary within fairly wide limits at comparatively low concentrations, but for stability of the solution must be rigorously controlled at higher concentrations, excess beyond a given limit resulting in rapid building up in metal content. At the lower concentrations, there did not appear to be a progressive increase in the electrode efficiency ratio, but actual slight decreases were noted. It was possible that at certain concentrations of cyanide polarisation of the anode might occur.

In regard to the conductivity of the solution, there was a very pronounced increase in this electrical property of the solution with progressive increase in free cyanide. Quite a substantial increase was, however, attained with free cyanide content of about 100 per cent. and, although better conductivity was obtainable with more cyanide, this was a safe figure to maintain. The effect of increasing free cyanide content upon the deposit was distinctly noticeable, there being a marked reduction in the grain size, the deposit also becoming white in colour.

A further drawback of the higher free cyanide content was the increase in gassing which resulted, particularly in the early stages of deposition. It was possible that this was due to the higher hydrogen overvoltage on cadmium as compared with iron, causing the gas evolution to slacken, and eventually to cease almost entirely when the cathode was well covered with cadmium. The anode corrosion obtainable with resultant cleanliness of anode surface was quite efficient in solutions of comparatively lower free cyanide content.

Effect of Increasing Alkali Content

Alkali was usually added as a means of increasing the conductivity of the solution. It was not an essential constituent, being completely omitted from some formulæ. Experiment had, however, indicated that the presence of a caustic alkali in the solution was of definite value, having a marked tendency to bring the electrode efficiency ratio nearer to unity. It was possible, too, by its use, to standardise the alkalinity of the solution. The ratio was found to decrease progressively as the alkali content (caustic soda was employed) was increased from 1.5 to 30 gm./l. On the other hand, contrary to expectation, the conductivity was not appreciably affected. The free cyanide content of the solution used was 56 per cent., calculated on the combined cyanide present.

The addition of the caustic soda was also found to have a markedly beneficial effect on the deposit, the grain size of which was progressively reduced, becoming structureless at the upper limit, and the colour decidedly whiter. Tendency to streaking and patchiness at the cathode, occurring occasionally in absence of caustic soda, were also found to cease when caustic was present. There was little gassing at the anode, which was rendered a dark-grey colour, remaining unfoiled, and showing uniform corrosion. Slight gassing occurred at the cathode only at the highest caustic concentration.

(To be concluded)

The Production and Uses of Tantalum

By G. Malcolm Dyson, Ph.D., A.I.C.

So much has been heard recently about the possibilities offered by the comparatively rare metal tantalum, especially in connection with industrial chemical operations, that no excuse is needed for introducing an account of the element and its compounds into this series of articles.

It was in 1801 that Hatchett, whilst examining a specimen of Massachusetts columbite which had been presented to the British Museum, discovered that this mineral contained the oxide of a new element, for which he proposed the name columbium. Almost at the same time, Ekeberg, a Swedish investigator, discovered in a new mineral (yttrotantalite) a new element for which the name "tantalum" was suggested. The name, according to Ekeberg, was bestowed on the metal because, "when placed in the midst of acids it is incapable of taking any of them up and saturating itself with them." Later on, in 1809, Wollaston conducted a series of experiments in which he tried to show that the two elements columbium and tantalum were identical, but it soon became clear that there were actually two separate elements being dealt with, although in many cases the minerals afforded a mixture of the salts of both.

Occurrence

Tantalum and columbium almost invariably occur together in a large variety of minerals, none of which are very widely distributed. The principal commercial source of the metal is the mineral tantalite, which is essentially a triple oxide of tantalum, columbium and iron. Columbite, an analysis of a typical specimen of which is given below, is also a mineral of the same class. Other of the more important minerals in which tantalum is found include pyrochlor, which is very similar to columbite save that calcium replaces the iron, and that appreciable quantities of thorium and cerium are present; while many of the rare earth minerals such as yttrotantalite, fergusonite and euxenite contain appreciable amounts of tantalum. Of quite a different type are the somewhat extensive deposits of titaniferous tantalum ore found in Malaya at Sungei Sebantun. This mineral, of which there is a fairly

large supply, has a composition as given in the second analysis below:—

	COLUMBITE. (Massachusetts).	STRUVERITE. (Malaya).
Titanium dioxide	—	45.74
Tantalum oxide, Ta ₂ O ₅	28.55	35.96
Columbium oxide	51.53	6.90
Tungstic oxide	0.76	—
Stannic oxide	0.34	2.67
Iron oxide	13.54	8.27
Manganous oxide	4.55	Trace
Zirconium oxide	0.34	—
Magnesia	0.42	—
Silica	—	0.2
Water	0.16	0.5

This new Malayan mineral, to which the name struverite has been given, forms a valuable potential source of both titanium and tantalum. It is a kaolinised granitic intrusion in hardened black shale.

Extraction

Commercially the mineral tantalite is preferred for the extraction of the metal. It is, in reality, a mixture of ferrous tantalate and columbate with a small part of the iron replaced by manganese, and containing in addition tin and tungsten. A grade of tantalite containing about 60 per cent. of tantalum oxide and only a few per cent. of columbium oxide is selected. The ore is hand-picked, crushed, and then ground to a fine powder, after which it is fused with about twice its weight of acid potassium sulphate. The fused mass is poured while hot into large earthenware pans full of water, and the disintegration of the melt is completed by forcing in live steam. The majority of the impurities dissolve during this process, leaving an impure mixture of tantalic and columbic acids. These are separated by sedimentation, and treated with ammonium

sulphide solution to remove tin and tungsten, while the residue from this process is boiled with dilute hydrochloric acid in order to remove any iron sulphide.

The crude mixture of tantalum and columbic acids from the previous operation is separated by means of hydrofluoric acid. There are two methods of conducting this separation on a commercial scale. In the first, the crude acids are dissolved in strong hydrofluoric acid of such a strength that the solution contains 14 per cent. of tantalum oxide. This solution is raised to the boiling point and an excess of potassium fluoride added. On cooling, potassium tantalofluoride separates in small crystals. A variant of this process is to fuse the crude acids with acid ammonium fluoride and precipitate as before with potassium fluoride. There is always the possibility that some potassium titanofluoride will be precipitated along with the corresponding tantalum salt, but it may be removed almost entirely by washing with water.

The second method, which succeeds best on a large scale, involves a fusion of the crude acids with potassium hydroxide in order to obtain the soluble tantalates and columbates, which are leached out with water and converted back again into the purified acids by precipitation with sulphuric acid. The purified precipitate readily dissolves in hydrofluoric acid, and on the addition of potassium fluoride the compound K_2TaF_7 is precipitated. The columbium is converted to K_2CbOF_6 , H_2O which remains in solution, being twelve times as soluble as potassium tantalofluoride. If the metal is the ultimate product aimed at, the tantalofluoride is boiled with ammonia and the acid filtered off and ignited, when tantalum oxide is obtained in a state of comparative purity.

The Metal

In 1824, Berzelius obtained a black powder by the reduction of potassium tantalofluoride with potassium, but it appears that it was only about 60 per cent. pure, so that his observations on the substance are of little value. Moissan succeeded in obtaining a better sample by reduction with carbon in the electric furnace. The specific gravity of Moissan's preparation was 12.8, which is about four units below the most recent determination; a fact which points to the presence of a considerable quantity of tantalum carbide or nitride in Moissan's specimen. In 1903, Bolton succeeded in devising a process for the production of ductile tantalum in quantity, and the element was then immediately utilised for the production of drawn wire electric lamps. During the period 1905-1911 the majority of metal filament lamps were produced from tantalum, since that metal was found to be comparatively sturdy in use and could be readily drawn out into wire of extreme fineness without any complicated annealing processes. It was the discovery of a process for making cheaper and more efficient filaments from tungsten that completely displaced tantalum from this field of operations. It is estimated that a hundred million lamps with tantalum filaments were produced.

Properties of the Metal

The present-day production of tantalum on a large scale presents several very real difficulties. Early attempts were made to effect the reduction to metal by simply melting the fluoride with calcium or potassium, or by the Goldschmidt process, using aluminium or mischmetal. In every case a very impure metal was obtained. The best process for the production of tantalum is the heating of pure dry potassium tantalofluoride with dry metallic potassium in an evacuated electric furnace. In this way a powdery tantalum is obtained which may be compressed into bars and fused by the passage of a heavy current *in vacuo*, the whole aim being to conduct the operations away from any gas.

PROPERTY.	TANTALUM.	TUNGSTEN.	MOLYBDENUM.	PLATINUM.
Density.....	16.6	19.6	10.2	21.4
At. Volume.....	10.9	9.9	8.4	—
Tensile Strength.....	130,000	490,000	260,000	{ Hard 54,000 Ann. 42,000
Compressibility.....	0.30×10^{-8}	0.28×10^{-8}	0.47×10^{-8}	—
Young's Modulus.....	19,000	42,000	—	—
Melting Point.....	2770	3350	2250	1755
Boiling Point.....	—	—	3617	3907
S.H. (Cal. per gm./°C.).....	0.0365	0.034	0.072	0.0323
Linear Coeff. Expn.....	7.9×10^{-6}	4.3×10^{-6}	5.15×10^{-6}	8.84×10^{-6}
Thermal Conductivity.....	0.13	0.35	0.346	0.1664
Temp. Coeff. Expn.....	0.00335	0.0051	0.005	0.0039
Electrical Resistance (Microhm/ c.c. 25° C. annealed).....	14.6	5.2	4.8	9.97

The numerical constants of the element tantalum are given in the table above, in comparison with those of tungsten,

molybdenum and platinum. The commercially pure metal contains 99.5 per cent. of tantalum, and considerably resembles platinum in appearance. It is very ductile and may be drawn from $\frac{1}{8}$ in. bar to wire a few mils. thick without annealing. It will be noticed from the above table that its linear coefficient of expansion and temperature coefficient of expansion are almost the same as those of soda glass, from which we may deduce the fact that tantalum can be sealed through glass in the same way as platinum. Tantalum electrodes for discharge tubes have been employed to a limited extent.

Applications of Tantalum

The questions in which both metallurgist and chemist are interested with regard to tantalum are, firstly, to what extent it can replace platinum in the chemical laboratory and factory, and secondly to what extent it can be used for acid-resisting plant. The general replacement of platinum by a cheaper and equally satisfactory substitute has always been a fascinating problem; but it is by no means certain that tantalum offers the final solution. It is unattacked by acids with the exception of hydrofluoric, but it is attacked by fused alkalis. Furthermore, although it has an extremely high melting point, it is not unaffected by heating. At temperatures over a red heat it is superficially converted to the oxide, and also absorbs nitrogen with the formation of tantalum nitride.

If heated in hydrogen it increases by 0.4 per cent. in weight, with the formation of either a hydride of tantalum or a solid solution of hydrogen in that element. In volume, tantalum absorbs over 740 times its own volume of hydrogen. This hydrogen has the effect of making the metal coarse-grained and extremely brittle. Pirani (*Z. Electrochem.*, 1905, **11**, 555) has shown that this hydrogen cannot be removed entirely by heating *in vacuo* unless the metal is actually melted. In addition, carbon also combines with the heated metal, rendering it brittle. It is, therefore, fairly obvious that for general laboratory apparatus for high temperature ignitions, etc. (including alkali fusions), tantalum is unsuitable, as it is for the majority of industrial chemical operations which are to be conducted at temperatures above a red-heat. For the construction of precision weights, tantalum has been internationally approved as a substitute for platinum; and dental and surgical instruments of tantalum have been successfully manufactured and used.

With regard to the manufacture of resistant chemical apparatus for low temperature work, tantalum offers much more scope, and seems to have a good potential field of service in front of it. Guthrie and Co., Ltd., of Accrington, and Siemens and Halske, to mention only two firms, are now producing comparatively large scale apparatus in ductile tantalum, which has a hitherto unattained degree of resistance to acid corrosion; at present the cost is approximately one-twelfth of the cost of platinum, and when this ratio is increased a little, as it undoubtedly will be, there is little doubt that the application of tantalum will be considerably extended.

Use in Electrical Practice

In electrical practice, tantalum offers several interesting features. The fact that it will absorb all the common gases when heated to a temperature short of its melting point has led to its use in the manufacture of radio valves, since it can function as its own "getter," and will automatically harden any vacuum in which it is heated. It has been stated that this fact alone will account for a considerable increase in the useful life of a valve. Again, in electrolysis on the large scale, tantalum presents interesting possibilities, in the fact that it is not attacked by fused sodium chloride, while on a small laboratory scale it furnishes an important advance on platinum for the quantitative determination of metals by electrolytic deposition. Metals will deposit on a tantalum cathode as readily as upon platinum, but since tantalum is not attacked by aqua regia the deposit can be rapidly and quantitatively removed from the cathode.

One interesting use for tantalum is in the construction of electrolytic valves for the rectification of alternating currents. The element shows a very pronounced valve action, and if two electrodes of tantalum are placed in sulphuric acid of accumulator strength, only one milliamp. will pass when the potential across the electrodes is maintained at 75 volts. The usual type of tantalum rectifier consists of a lead and a tantalum electrode immersed in a suitable electrolyte and connected to input and output through a choke.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

"Silveroid" at Imperial Chemical House

THERE are fashions in metals, as in most other things, and bronze, which has had an innings of some thousands of years as a decorative metal, has of late been a good deal superseded by the white metals and finishes, employed no less for beauty than for wearing qualities. This excludes the soft white metals, although the recent cold spell has shown that more dependence is to be put on lead pipes than on some less yielding materials. Stainless steel is both ornamental and durable, and can be wrought into shapes and used for decorative table purposes. To a limited extent it is being used for the doors and runners of lifts, and has been so employed in London's latest palatial office building, Imperial Chemical House.

Most of the decorative effects, so far as metal work is concerned, have, however, been carried out in the beautiful nickel-copper alloy "Silveroid." This is very hard, and highly corrosion-resisting, and has been selected because, from this point of view, its employment obviates a tremendous amount of cleaning and polishing, which would have been necessary in the case of most other metals used for similar purposes. "Silveroid" is made of pure nickel and electrolytic copper, in the proportion of about 45 per cent. of the former to 54 per cent. of the latter. A little manganese is added to secure sound castings and to increase the tensile strength. In Imperial Chemical House, the alloy has been extensively used, both cast and rolled, for plaques, stair railings, balustrades and grilles, and, in particular, as railings along the colonnade, where any metal work would be especially prone to be tarnished if not actually corroded by the damp and fogs of the adjacent river, unless, like "Silveroid" it possesses, in a very marked degree, the corrosion-resisting properties of which mention has been made. In the internal fittings, mouldings and panelling a "matt" finish has in many cases been preferred, and the general effect, as visitors to Imperial Chemical House will find, is exceedingly pleasing.

What is Welding?

It is almost time that sticklers for exactitude in the use of terms should come to some decision as to the overworked word welding, which is now applied to the description of many operations in the joining both of ferrous and non-ferrous metals, none of which, or at least only one of which, corresponds strictly with the original meaning of the word. Professor Desch, in his address at the Faraday Society symposium on cohesion, was careful to use it in what may be regarded as its classic sense—the union of steel in a plastic state, by hammering or squeezing—which he extended from the older methods employed by the smith to the "resistance welding" of the present day. He actually excluded oxy-acetylene and arc-welding and, by implication, fusion welding generally, as belonging to "a different category." He also discriminated between welding and sintering, as well as swaging, of the kind that Dr. Smithells, in his book on "Tungsten," describes as being applied to that metal, and in which some at least of the modes and effects produced appear legitimately to belong to the category of "welding." Stoughton and Butts, in their book on "Engineering Metallurgy," recognise the classical sense, but roundly declare that there is "no scientific distinction between brazing, soldering, and so-called fusion welding." This has the merit of being plain and of leaving welding proper where it was, except that they define it as "joining two metallic pieces by diffusion under pressure." Probably diffusion always does occur, sooner or later, in properly joined metals, and often, even, in electro-deposits of one metal upon another in which some degree of mutual solubility exists. The old view, which was manifestly too narrow, was that certain varieties of iron and steel were alone capable of being welded, and in the sense in which the word was then used aluminium, for example, did not *weld*, for the welding process proper stopped short of fusion. On the other hand, the modern view, which includes thermit welding and a host of methods which consist of fusing like metals together, and even of joining unlike metals together by fusing another between them (which is no more or less than a soldering operation pure and

simple), seems to extend the term welding unduly far beyond its legitimate meaning.

Technical Literature as Propaganda

WITH the exception of the *Mond Nickel Bulletin*, there is, in this country, not a single periodical devoted either to commercial propaganda or to the technical progress of any specific non-ferrous metal. America has publications of uncertain merit devoted to zinc and to copper respectively. They are commercial, rather than technical. The *Mond Nickel Bulletin* is essentially technical, but, as has been said, it forms an exception. These reflections are aroused by the perusal of the *Revue de l'Aluminium et de ses Applications*, which is published bimonthly in Paris. This is a technical periodical first and foremost; that it is propagandist is, from the point of view of its general utility to the reader and its very real technical interest, quite a secondary consideration. A survey of the contents of the last issue will make this plain. The first article is on the influence of heat treatment on the hardness of 8 and 10 per cent. copper-aluminium alloys cast in chills, and is by J. Suhr. It is an original article, and not simply the reprint of a paper read before some society. The next is an abstract of an Académie des Sciences' communication by R. de Fleury, on aluminium pistons. Then follows an illustrated account of the employment of duralumin and of alpac in the aerial mountain railway to Chamonix, by J. Bally. Another illustrated article describes the erection of aluminium statues of the Virgin upon various Alpine peaks. It is followed by one on the use of aluminium for sledges, and by another (translated from an American source) on high tensile aluminium locomotive parts. Finally Dr. Germaine Marchal's recent article in the *Revue Générale des Sciences* on beryllium is reproduced *in extenso*.

Beryllium

THE article on beryllium referred to above is devoted, in the main, to the various methods employed for the preparation of the metal, and brings the literature of this aspect of the subject up to date. As made by electrolysis from the fused chloride it can be rendered practically pure, containing at most 0.05 per cent. of iron, carbon, aluminium and magnesium, and less than 0.005 per cent. of nitrogen. By re-fusion in an induction furnace lined with beryllia the carbon can finally be eliminated and no more than 0.02 per cent. of iron retained, whereupon the metal is less susceptible to acid attack. In regard to its properties, the latest melting point determinations are given, the results of Fichter and of Oestecheld being quoted. According to the former beryllium melts at $1280^{\circ} \pm 20^{\circ} \text{C}$., while the latter gives the melting point of a 99.5 per cent. pure metal as $1278^{\circ} \pm 5^{\circ} \text{C}$. It volatilises under pressure at 1520°C ., and has the highest heat of fusion of any metal, this being according to Crompton 341 calories per gram-molecule. In other circumstances, its boiling point is over 1900°C . Its hardness is 6.7 (aluminium = 2.9) and its elastic modulus is once again stated to be the stereotyped 30,000 kilogrammes per square millimetre hitherto ascribed to it. Owing to its relative scarcity and the cost of its preparation, the author sees no immediate likelihood of beryllium assuming any very great importance in industry.

The Empire Congress

DURING the course of the third Empire Mining and Metallurgical Congress, which will take place in South Africa in the period March 24 to May 8, 1930, a tour of the country will take place. The Empire Council of Mining and Metallurgical Institutions, under whose auspices the congress will be held, have issued a booklet on the itinerary of the tour. The approximate cost will be £140, the duration being 47 days. Members will be conveyed in special de luxe trains. Among the places visited will be Capetown, Kimberley, Johannesburg, Mafeking, Bulawayo, Bwana M'Kubwa, Victoria Falls, Zimbabwe, Pretoria, Kruger National Park (game preserve), Ladysmith, Durban, Bloemfontein, and Port Elizabeth. Further details of the congress and tour may be

obtained from The Secretary, Third (Triennial) Empire Mining and Metallurgical Congress, P.O. Box 4,604, Johannesburg, Transvaal, Union of South Africa.

Iron and Steel Statistics

A NEW edition of *Statistics of the Iron and Steel Industries* (1927) has just been published by the National Federation of Iron and Steel Manufacturers, and may be obtained, price 5s. 4d., post free, from the offices of the Federation, Caxton House [East], Tothill Street, Westminster, London, S.W.1.

This new edition follows in the main those issued in the past few years, but further additions have been made to the information concerning the respective countries in order to make the statistics as complete as possible. A summary table is included showing the world output of iron ore for the last few years. The new section introduced last year dealing with tariffs on imports of iron and steel into certain countries has now been greatly enlarged by the addition of extracts from the tariff schedules of ten countries. With regard to the United Kingdom, the production statistics are based upon returns supplied to the Federation by iron and steel manufacturers throughout the country; owing to their co-operation the figures are now more complete than at any other period. Returns of pig iron production are received from all makers without exception, and in the case of steel, from all manufacturers of steel ingots. It is the aim of the publication committee to make each new edition still more complete, and any suggestions for additions or improvements will be welcomed.

Information on Aluminium

A GROUP of five interesting pamphlets on the uses and properties of aluminium have just come to hand from the British Aluminium Co. "Aluminium Chemical Plant" is a reprint of a lecture given on the subject by Mr. E. T. Painton, at the Sir John Cass Technical Institute, which was reported in *THE CHEMICAL AGE* of December 1, 1928 (pp. 510-512). "The Lightest of Common Metals" is a group of interesting photographs of the varied products into the manufacture of which aluminium enters, ranging from flying boats and racing cars to portable typewriters and bathroom fittings. "Aluminium Bronze" gives a very interesting and compact account (pp. 76) of this interesting substance, dealing with the foundry technique, the influence of other metals, heat-treatment, notes on die-casting, wrought alloys, etc. It is addressed to those who are attracted to the obvious possibilities of aluminium bronze, and who fear its pitfalls. It is pointed out that we stand as a nation much in regard to aluminium bronze as we do to many similar advances in metallurgical science. That is to say, whilst retaining a lead in fundamental research, we have left the practical application of that research largely to foreign enterprise, notably American. A number of concerns in this country have, however, done valuable pioneer work and established thriving industries in this material.

The fourth pamphlet deals with "Aluminium Sheet Metal Work."

Medical Reports on Aluminium Ware

FOR many years past the public has been interested in cooking vessels made of aluminium. Special interest therefore attaches to the last of the British Aluminium Co.'s pamphlets, entitled, "The Lancet Reports on Aluminium Ware." This consists of two reports published in *The Lancet*, the well-known British medical organ, on investigations carried out under its auspices on the use of aluminium ware for cooking and similar purposes. The first of these was published on January 4, 1913, and the second as recently as December 15, 1928.

The conclusion reached in the former was that aluminium did not communicate poisonous properties to food in the processes of cooking. In order to render assurance doubly sure, the second investigation was made, since, as *The Lancet* points out, statements have been made from time to time that "traces of aluminium in foodstuffs are harmful, and the astounding allegation has been made that cancer may be attributable to food prepared in aluminium vessels." The view put forward as a result of the second investigation is as follows: "Although the published data on the toxicity of aluminium are very meagre, the general consensus of opinion appears to be that small quantities are without effect on the living organism. It would appear that aluminium vessels, if of suitable purity, are perfectly safe for cooking purposes,

and even if small quantities are conveyed to the water or food, these are without influence on the health of the individual." This authoritative declaration should completely reassure even the most nervous.

United States Consumption of Primary Tin

THE consumption of tin in the United States is so large that the annual imports amount to about one-half of the world's production of that metal, according to the United States Bureau of Mines, Department of Commerce. As the result of a canvass made to ascertain the amount of tin consumed for different purposes in the United States during 1927, the Bureau found that 24,527 long tons of primary or virgin tin were used in the manufacture of tin plate andterne-plate, accounting for 35.65 per cent. of the total consumption of primary tin in the United States in that year. Next in order of magnitude as a consuming factor is solder, which required 13,734 long tons, or 19.96 per cent. of the total. The manufacture of babbitt required 8,705 long tons, and foil and collapsible tubes consumed 6,903 long tons. The results of the Bureau's inquiry, wherein effort was made to eliminate figures relating to secondary tin, account for 68,797 long tons of primary tin, a quantity equivalent to 96.7 per cent. of the imports in 1927. The results of this canvass, based on reports from 1,050 concerns, are tabulated in Information Circular 6084, "Consumption of Primary or Virgin Tin in the United States," by J. B. Umhau, copies of which may be obtained from the United States Bureau of Mines, Department of Commerce, Washington, D.C.

Magnesia and Silica Crucibles

YET another publication of the U.S. Bureau of Mines, Serial 2896, by C. N. Schuette, deals with the production of silica and magnesia crucibles in the induction furnace, this having been achieved in the laboratory of its Pacific Experiment Station. The essential new parts of this work are the development of a technique for the high-frequency furnace production of silica crucibles of greater wall thickness than could be readily fabricated from commercial fused silica, and for heavy-walled magnesia crucibles of great density and mechanical strength. A description is given of the method employed, which produced crucibles of excellent quality in a reasonable time and with a moderate expenditure of power and materials.

British Metals Corporation in Canada

THE British Metals Corporation, which recently secured an interest in the Tidewater Smelters at Ladysmith on Vancouver Island, will (states the Canadian Natural Resources and Industrial Information Bureau) put this plant into active operation as soon as sufficient ore shipments are available. The facilities at the smelter may later be expanded so as to include the production of refined metal.

Canadian Tariff Alteration and Copper

THE Federation of British Industries has called a meeting of its Non-Ferrous Metals Group at an early date for the consideration of the question of the proposed alteration in the British preferential basis in the Canadian tariff. It will be remembered that in connection with this alteration, whereby a certificate has now to be signed by British manufacturers exporting to Canada to the effect that 50 per cent. of raw material and/or labour are included in any article, and that these are the product of a British country, the F.B.I. pressed the Canadian Government to consider the issue of a list of exceptions similar to the list issued by the New Zealand Government when that Dominion brought into operation a ruling of an almost identical nature. The Canadian Government did not see its way to issue such a list but is said to be prepared to consider individual cases where British manufacturers cannot sign the 50 per cent. certificate.

Manufacturers of copper are naturally greatly interested in this alteration, which is likely to affect them very closely, and it is in order to consider the question from every view, to decide what representations may be made to the Canadian Government and what form those representations should take, that the F.B.I. has summoned the meeting of the Non-Ferrous Group. Other trades affected are the producers of certain types of chemical preparations which may contain a large percentage of a drug or drugs which are unprocureable in the British Empire.

Trade, Commerce, Finance: The Month in Review

From Our Market Correspondent

OUTWARDLY, there seems to have been little change in the iron and steel trade during the month of February. District reports speak of a steady volume of trade, and indicate that the slight improvement which marked the beginning of the year has been maintained. As a superficial view that appears to be somewhere near the mark. Actually the position is rather different, and influences are at work which are rather disconcerting to those who are entrusted with the task of running the steel works.

Price of Steel Scrap

Foremost of these trade currents is the sensational rise in the price of heavy steel scrap. Although this commodity plays an important part in the process of steel making, it has remained rather in the background until recent months. Prior to the war, more pig iron and less scrap was used in the steel furnaces, owing to the relative cheapness of the pig iron, the proportion being about 70 per cent. of pig and 30 per cent. of scrap. As the value of these materials changed, so did the quantity used, so that to-day the figures are more like 50 per cent. of each. Hitherto supplies of scrap have been available as required, and the price has moved within fairly narrow limits.

The last few months, however, have witnessed a striking change in the situation. During the past year there has been a constant demand from abroad for good heavy scrap, the price obtainable being more favourable than that offered by the steel makers here. Consequently there has been a steady drain on the supplies, which, together with the home demand, has slowly but effectively cleared out the accumulated surplus, and the position has been reached where the quantity of scrap available is not sufficient to meet the export plus the home demand.

The inevitable result has been a constant appreciation in price, until to-day scrap is 12s. 6d. to 15s. per ton higher than it was six months ago. Not only that, but steel makers in every district are finding the utmost difficulty in obtaining sufficient to feed the furnaces. A further increase in price is therefore bound to follow quickly, and it is confidently expected that 2s. 6d. to 5s. per ton more will be put on the present price within the next week or two.

The Export of Scrap

It was foreseen that this situation would arise, and representations were made some months ago to the Board of Trade in the hope that action could be taken to prohibit the export of scrap, but of course nothing could be done; as there was no machinery which the Board of Trade could set in motion for the purpose. Such considerations do not weigh with our competitors on the Continent, who have no hesitation in stopping the export of scrap as soon as such a movement is adverse to their steel industry.

Obviously if scrap cannot be obtained in sufficient quantity, or if the price becomes too high, the steel makers will have to revert to the use of a larger proportion of pig iron. Unfortunately, there is at present no excess supply of basic iron available, and a material increase in the demand will necessitate the starting up of additional blast furnaces.

At once the pig iron makers will be confronted with another problem. The supply of blast furnace coke has been cut down owing to the shortage of coking slack, so that at present there is hardly sufficient to keep pace with the requirements of the blast furnaces already in operation, indeed it is only with difficulty that the furnaces can maintain their output. It is doubtful whether sufficient coke could be obtained to feed additional blast furnaces, but if it were, the price would be put up accordingly. Whichever way the steel maker turns, therefore, he is confronted with a serious advance in the cost of production as well as a probable curtailment of output which will still further increase the cost. Already we know of two large steel works which have had to reduce the number of furnaces in operation solely because of the shortage of scrap and the inability to replace it with pig iron.

The Outlook

No doubt the position will right itself in time. Either the present boom in scrap will subside and supplies be forthcoming, or the coke makers will take advantage of the situation

to increase the output of coke and so enable enough pig iron to be produced to replace the scrap. Whatever happens, the steel maker is the loser. The figures already given in regard to scrap will show what an addition to the cost of production is involved. The increase in the price of coal and coke has to be added, and that is not yet finished. The coke makers are still putting up the price for new contracts, and there is a movement afoot for the control of coke supplies which is likely to stiffen the price still further.

What can the steel maker put against these advances? The official price of steel plates and sections remains the same as it was a year ago, and it is no use any maker quoting more, as the orders are nothing like sufficient to keep all the mills busy. Those prices were not profitable when they were fixed, especially when the rebate of 10s. per ton is taken into account. With the increased cost of production they become definitely losing prices, and as the officially controlled materials, steel plates and sections, constitute a large proportion of the finished output of the steel works the immediate outlook is far from promising.

Advances have been made in the prices of some of the uncontrolled materials, such as billets and small bars, but on the other hand boiler plates have steadily receded in price. Some makers have endeavoured to increase the price of uncontrolled materials so as to keep pace with the advance in production costs, and where quality and service are of first importance they have to some extent succeeded, but there are still far too many steel makers who are ready to underquote their competitors in order to secure business, and this attitude is quite effective in preventing any adequate adjustment between costs and selling prices.

Adjustment of Prices Necessary

Such an adjustment is urgently necessary. The Board of Trade ascertainment showed that the price index of steel in December was 112.3, while the figure for other commodities was 138.3. Such a difference represents a heavy drawback to the steel trade and justifies an alteration in the official selling prices of steel. The only reason one can find for the retention of the existing prices is a political one. With the approach of the general election and the renewal of the claim for safeguarding it may be thought inadvisable to increase prices at present, but that is a doubtful argument. So far, the steel makers have had to face the advances in cost without any prospect of recouping themselves, and if this goes on much longer some of the works will cease to have any further interest in either costs or selling prices.

The pig iron market has remained firm in tone during the past month, and there seems to be no necessity to forgo any of the 2s. 6d. to 3s. per ton advance which has operated for some weeks past. The actual amount of new business is slightly less than it was a week or two ago, but orders are being received in good volume at the furnaces. Should the improvement be maintained, as makers hope it will, there is the probability of further furnaces being blown in, particularly in the Cleveland district, where the supply is hardly equal to the demand. Hematite is also firmer and the price has advanced 1s. to 2s. per ton. There is no great change in the finished iron trade, although there will probably be an advance in the price of iron bars owing to the extra cost of forge pig iron. There is not likely to be any real improvement in the finished iron trade, and several of the works have turned to re-rolling as the only means of keeping in existence.

Finished Steel Trade

The condition of the finished steel trade has already been indicated. Billets and small bars seem to be the busiest sections. There is not much buying of continental steel, and the home demand for billets has developed sufficiently to enable makers to put the price up 5s. per ton. The small bar mills generally are busier, although for ordinary qualities of steel the price remains at a very low level. In steel plates and sections there is no further improvement, and the specifications that are available are speedily cleared off by the mills.

The output of pig iron during January was 563,900 tons, compared with 540,400 tons in December, and there were seven additional furnaces in blast. The output of steel was 761,600 tons, compared with 683,100 tons in December.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature, published weekly in THE CHEMICAL AGE.

Concentrating Ores

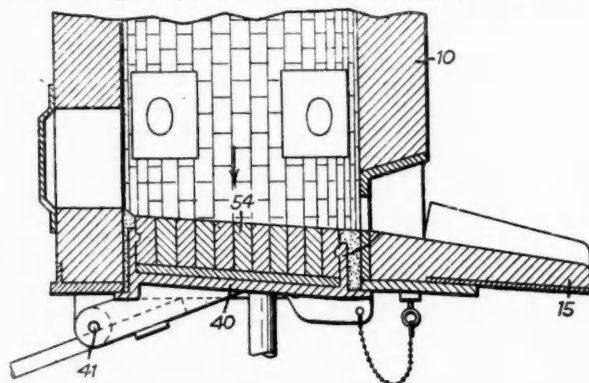
REAGENTS for use in froth flotation processes are obtained by interaction between a hydrocarbon and sulphur in presence of a metal and of chlorine. Specified reagents are those obtained from (1) benzene, sulphur chloride, and zinc; (2) benzene, sulphur, and aluminium chloride; and (3) *n*-heptane, sulphur chloride, and zinc. See Patent Application 301,832, bearing the International Convention date December 6, 1927, by Minerals Separation, Ltd., of London, Assignees of C. H. Keller, of San Francisco, U.S.A.

Copper

COPPER is extracted from ores in which it is present as silicate by treating the finely-divided ore with an ammoniacal solvent such as a solution of ammonium carbonate. The ore is ground with water to a slime pulp, which is filtered in a press and dewatered to a moisture content of less than 20 per cent. by forcing air through the press. The solvent is then forced through the cake in the filter. See Patent Application 301,859, bearing the International Convention date December 7, 1927, by Anglo-American Corporation of South Africa, Ltd., of Johannesburg.

Furnace

A FURNACE specially adapted for melting non-ferrous metals such as copper, brass, bronze, zinc, or tin comprises a cupola portion 10 and a removable bottom member 40, hinged at 41, and carrying a fire-resisting lining 54 movable to and from the operative position as a unit therewith, the upper surface of the lining being in contact with the metal in the furnace.



303,042

This upper surface slopes toward the tap spout 15 for discharging the molten metal. The arrangement facilitates removal of the bottom member for repairs or replacement, and rapid opening and cleaning of the furnace. See Specification 303,042, dated September 26, 1927, by D. Cushing, of Cambridge, Massachusetts, U.S.A.

Heat Treatment of Metals

METALS and alloys not adapted for cementation, *e.g.*, copper or brass, are heated in fused salt baths of a thin consistency which contain small amounts (10 per cent. or less) of oxidisable substances, such as cyanides or finely-divided carbon, serving to prevent the formation of scale. The metals etc., are preferably preheated in a non-oxidising atmosphere before immersion in the bath. See Patent Application 302,642, bearing the International Convention date, December 19, 1927, by Chemische Fabrik Weissenstein Ges., of Weissenstein-on-Drau, Austria.

Iron

FOR refining iron or steel, cerium or a ferro-alloy thereof is employed in association with other elements, *e.g.*, vanadium, titanium, aluminium, calcium, magnesium, or silicon, having a similar action on the impurities. The use of an alloy consisting of 25 to 40 per cent. of vanadium, 2 to 40 per cent. of

cerium, and the remainder iron is specified. See Patent Application 302,574, bearing the International Convention date, December 17, 1927, by I.G. Farbenindustrie, Akt-Ges., of Frankfurt-on-Main, Germany.

A METHOD of operating a blast furnace using oxygenated air is described and claimed in Specification 303,206 (White), dated August 30, 1926, a communication from S. G. Allen, of New York, U.S.A. A degree of oxygenation is used, such as would cause excessive smelting capacity as compared with shaft reduction capacity, and the ratio of ore to coke in the charge is correspondingly increased. If the reducing power of the gases in the shaft section of the furnace is lowered unduly, reducing material such as fuel oil or gas or pulverised fuel is introduced into the lower end of the shaft.

A METHOD of producing ferro-manganese and other ferro-alloys by blast furnace reduction of ores is described and claimed in Specification 303,207, by the same claimants as the above, dated August 30, 1926. The ratio of ore to coke is increased to ensure efficiency of operation in the shaft section of the furnace, and efficiency in the smelting zone is ensured by so enriching the blast with oxygen that the temperature of the exit gases from the furnace is between 250° and 400° F., preferably about 300° F. Still more oxygen may be used in the main blast, in which case the otherwise detrimental effect in the shaft section is obviated by introducing additional oxygen or air at a point or points above the mantle. A substantial portion or the whole of the fuel component of the charge may be introduced at the tuyère level. The method is stated to permit of the blast furnace production of ferro-alloys not hitherto made by pyro-metallurgical processes.

Reduction of Ores

A METHOD of reducing iron ores, and apparatus for use in reducing ores in general, especially copper and nickel ores, are described and claimed in Specification 304,174, dated October 10, 1927, by F. L. Duffield, of London. As applied to iron, the method comprises introducing a charge of ore and carbon with or without lime at the base of a reducing chamber, raising the charge through successively hotter zones of the chamber, and discharging the iron at or near the top of the chamber. The gases evolved are collected at the top of the reducing chamber and in admixture with air, are burned as they descend through a combustion chamber, so arranged as to supply its heat to the reducing chamber. The apparatus, as applied to the reduction of ores in general, comprises a vertical furnace, a horizontal ram for introducing the charge into the bottom of the furnace, a vertical ram for raising the material within the furnace, a one-way cock to hold up the material on the back stroke of the vertical ram, shoots for the discharge of the metal, and passages for supplying the gases generated to combustion chambers contiguous to the furnace.

Tin

IN the extraction of tin from cassiterite and other tin-bearing ores, residues, concentrates, etc., the material is treated with ferrous chloride and/or zinc chloride in conjunction with iron, zinc, or other suitable reducing agent to convert the tin into stannous chloride. This is then separated by distillation or by lixiviation, and the tin recovered from it electrolytically, or by fusion with zinc, or by treating its aqueous solution with ammonia to precipitate the hydroxide, which is reduced by means of charcoal. Various arrangements for the recovery and further use of the reagents in a cycle of operations are described in detail. See Specification 302,851, dated April 5, 1928, by E. A. Ashcroft, of Ashburton, Devon.

TIN is extracted from oxide ores, concentrates, etc., by first heating the material with a reagent adapted to convert the tin into a sulphide, which remains in the material in pulverulent form and is soluble in a suitable reagent; and thereafter extracting this sulphide by leaching with the reagent. The conditions of the sulphidising operation should be such that the tin sulphide is not volatilised and that the material remains porous, to facilitate the leaching operation. Solutions of alkaline sulphides or polysulphides, such as ammonium polysulphide, are specified as suitable leaching reagents, and the tin may be recovered from the solutions by electrolysis. Any arsenic present in the ores, etc., is converted into sulphide, which is recovered, free from tin, by condensing the fumes from the sulphidising operation. See Patent Specification 301,553, dated June 13, 1927, by H. L. Sulman and H. F. K. Picard, of London.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

- ALLOYS.—The alloys of gold with platinum. A. T. Grigorjew. *Zeitschrift anorganische Chem.*, Vol. 178, Parts 1-3, pp. 97-107 (in German).
- Investigations on the silver-copper eutectic. J. A. A. Leroux and E. Raub. *Zeitschrift anorganische Chem.*, Vol. 178, Parts 1-3, pp. 257-271.
- Constitution of aluminium-copper alloys. E. H. Dix, Jr., and H. H. Richardson. *Trans. Amer. Soc. Steel Treating*, February, pp. 368-370.
- ALLOYS, CORROSION-RESISTING.—Chromium-copper steels as possible corrosion resisting ferrous alloys. B. D. Saklatwalla and A. W. Demmler. *Trans. Amer. Soc. Steel Treating*, January, pp. 36-48.
- ANALYSIS.—The determination of molybdenum in steel in the presence of tungsten and vanadium. J. Kassler. *Zeitschrift analytische Chem.*, Vol. 76, Parts 3-4, pp. 113-119 (in German). Tungstic acid is precipitated by solution of 5g. of steel in 80 c.c. of concentrated hydrochloric acid and oxidation with 10 c.c. of concentrated nitric acid, and the solution concentrated at 80-90° C., in order to obtain the tungstic acid as free as possible from molybdic acid. The molybdic acid is separated from the precipitated tungstic acid, not by filtration and washing, but by partial filtration.
- A rapid method for the determination of the tin content of tin plate. W. A. Masel. *Chemiker-Zeitung*, February 6, p. 108 (in German).
- CORROSION.—The electrical behaviour of surfaces of corroding iron. A. L. McAulay and S. H. Bastow. *J. Chem. Soc.*, January, pp. 85-92.
- The passivity of metals. II.—The breakdown of the protective film and the origin of corrosion currents. U. R. Evans. *J. Chem. Soc.*, January, pp. 92-110. Breakdown of the protective film in iron, steel, zinc or aluminium tends to occur where the surface has been bent or cut, or where rolling or casting defects occur at the surface. At these points local corrosion sets in, and usually spreads out, although where dissolved oxygen is in excess the weak point often heals up again and the corrosion does not develop.
- The mechanism of corrosion. U. R. Evans. *J. Chem. Soc.*, January, pp. 111-129. A study of the corrosion of partly immersed specimens of zinc, iron, steel, aluminium and copper in potassium chloride and sulphate solutions, with special reference to the thin films which give rise to interference colours in certain parts of the specimens. It is suggested that these films are due to precipitated hydroxide.
- Inter-crystalline corrosion of nickel. W. Köster. *Zeitschrift Metallkunde*, January, pp. 19-21 (in German).
- STEEL.—Solubility of carbon in normal and abnormal steel. O. E. Harder and W. S. Johnson. *Trans. Amer. Soc. Steel Treating*, January, pp. 49-68.
- Austenite decomposition and length changes in steel. E. C. Bin and W. S. N. Waring. *Trans. Amer. Soc. Steel Treating*, January, pp. 69-95.
- The effect of furnace atmospheres on steel. R. G. Guthrie. *Trans. Amer. Soc. Steel Treating*, January, pp. 96-116.
- Surface cooling of steels in quenching. H. J. French, G. S. Cook, and T. E. Hamill. *Trans. Amer. Soc. Steel Treating*, February, pp. 217-288.
- The manufacture of acid open-hearth steel for forging ingots. H. P. Rassbach. *Trans. Amer. Soc. Steel Treating*, February, pp. 289-302.
- STEEL, NITRIDED.—Methods of approximating certain physical characteristics of nitrided steel cases. G. M. Eaton. *Trans. Amer. Soc. Steel Treating*, January, pp. 1-35.
- SURFACE FILMS.—The surface oxidation of aluminium, tungsten and molybdenum. L. C. Bannister. *J. Chem. Soc.*, December 1928, pp. 3163-3166.
- Oxide films responsible for the tints on heated copper. U. R. Evans. *Nature*, January 5, p. 16. The tints of heated copper are attributed to cuprous oxide. Cupric oxide is said to obscure the colours.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette, &c.

Company Winding Up Voluntarily

BRAND'S PURE SPELTER CO., LTD.—At an extraordinary general meeting of the above-named company, held at 200, Buchanan Street, Glasgow, on Thursday, February 14, the subjoined Extraordinary Resolution was duly passed:—"That it has been proved to the satisfaction of the shareholders that the company cannot, by reason of its liabilities, continue its business, and that it is advisable to wind up the same, and accordingly that the company be wound up voluntarily, and that Andrew Simpson Macharg, chartered accountant, 120, St. Vincent Street, Glasgow, be and he is hereby appointed liquidator for the purpose of such winding up." Meeting of creditors, at the offices of M'Clelland, Ker and Co., chartered accountants, 120, St. Vincent Street, Glasgow, Monday, March 4, at 2.30 p.m.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ASIUM ALLOYS, LTD., London, E.C.—Registered February 8, £300 debentures, part of £2,000; general charge. *£1,000. August 1, 1928.

BALDWINS, LTD., London, E.C., coal and iron masters. Registered January 18, trust deed dated January 9, 1929 (supplemental to trust deeds dated July 4, 1921, etc.), securing £2,250,000 7½ per cent. debenture stock, and executed in pursuance of a scheme of arrangement under sec. 120 of the Act whereby A 6½ per cent. debenture stock and income debenture stock were to be issued to 7½ per cent. stockholders, etc.) securing £1,206,850, part of said 7½ per cent. debenture stock now designated A 6½ per cent. debenture stock, and premiums on stock redeemed during 1929 1 per cent., 1930 2 per cent., 1931 3 per cent., 1932 4 per cent., and thereafter 5 per cent.; charged on properties and investments comprised in schedules filed with the particulars, in substitution for charges created by previous deeds, subject, etc.; also registered January 18, trust deed dated January 9, 1929 (executed in pursuance of scheme of arrangement as above), securing £1,206,850 income debenture stock divided into £482,740 convertible stock repayable at a premium of 5 per cent., and £724,110 non-convertible stock repayable at a premium of 20 per cent.; general charge (subject, etc.). *£2,649,100. December 14, 1927.

KAMRA TIN DREDGING, LTD., London, E.C.—Registered January 28, series of £40,000 debentures, present issue £30,000; general charge.

MIDLAND COAL, COKE AND IRON CO., LTD., Newcastle (Staffs.).—Registered February 8, supplemental trust deed dated February 1, 1929, securing £10,000 notes; charged on certain debentures, etc. *£591,044. March 1, 1928.

YOUNG (T. W.), LTD., London, E.C., metal manufacturers.—Registered January 28, £4,000 debenture, to E. W. Trott, Poynings Park Way, Golders Green; general charge. *Nil. August 14, 1928.

Satisfactions

AFRICAN MANGANESE CO., LTD., London, E.C.—Satisfaction registered January 26, £20,000, part of amount registered April 13, 1923.

ALUMINIUM CORPORATION, LTD., London, S.W.—Satisfaction registered January 28, £300, registered August 23, 1923.

BALDWINS, LTD., London, E.C., coal and iron masters.—Satisfaction registered February 5, £500,000, registered October 28, 1902, July 5, 1909, and May 13, 1921.

CARGO FLEET-IRON CO., LTD.—Satisfaction registered January 28, £9,700, part of amount registered January 23, 1905.

PORT TALBOT STEEL CO., LTD.—Satisfaction registered February 8, £300,000, registered April 8, 1914.

Monthly Metallurgical Section

Published in the first issue of "The Chemical Age" each month.

NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

Arsenic: Its Occurrence, Properties, and Applications

(FROM A CORRESPONDENT)

The fact that arsenic is, more often than not, regarded as a nuisance from the metallurgical standpoint, gives it a unique position among the elements. Nevertheless, it is not without some extensive and interesting applications, of which an account is given in this article.

HISTORICALLY, arsenic has been known for a long time, and even the ancients were acquainted with the poisonous and alloying properties of arsenic. Apparently the early philosophers regarded it as a form of alum, since the Greek writer Olympiodorus refers to it as "white alum," and gives a method of preparing the trioxide by the roasting of the sulphide in an abundant supply of air. In the so-called works of Basil Valentine arsenic is referred to as "hüttenrauch" (literally "furnace smoke"), so that it is obvious that he was acquainted with its production as a by-product of metallurgical operations.

Arsenic was used first as a caustic and depilatory, and, of course, it had extensive use as a convenient poison in medieval times. Several curious documents concerning the use of arsenic as a poison have been preserved, and one is so curious as to warrant a short quotation here. It is nothing less than a commission issued by Charles le Mauvais to a certain Woudreton, to murder by arsenic Charles VI and certain others. It runs:—"Go thou to Paris; thou canst do great service if thou wilt; do what I tell thee; I will reward thee well. Thou shalt do thus; there is a thing called sublimed arsenic; if a man eat a bit the size of a pea he will never survive . . . draw near . . . and put the powder in the soups, meats or wines, provided that thou canst do it secretly." Woudreton was caught red-handed, and executed in 1384.

Occurrence

The element arsenic is occasionally met with native, but native arsenic cannot be considered as more than a curiosity, and does not constitute a commercial source of the element. In some ways, arsenic is very widely distributed, since nearly every mineral in which metals occur contains a certain amount of it. This is very apparent in the copper, nickel and cobalt minerals, many of which form commercial sources of arsenic. Among the ores of arsenic we may mention the two sulphides realgar, As_2S_2 , and orpiment, As_2S_3 , both of which have been used from time to time, as red and yellow pigments. The oxide, As_2O_3 , is occasionally found alone, and constitutes the mineral arsenite. The remainder of the arsenic minerals can be divided into two main classes, the arsenates and the arsenides. The arsenides are far more common than the arsenates and are mentioned first in the list of arsenic minerals which follows:—

Arsenical pyrites (Mispickel)	FeS_2As
Arsenical Iron	$FeAs_2$
Tin White Cobalt	$(CoNiFe)As_2$
Arsenical Nickel	$NiAs$
Cobalt Bloom	$Co_3(AsO_4)_2 \cdot 8H_2O$
Mimetesite	$2Pb_3(AsO_4)_2 \cdot Pb_2(PO_4)Cl$
Pharmacolite	$(HCaAsO_4)_2 \cdot 5H_2O$

In many cases, the removal of the arsenic present is a necessary preliminary to the various metallurgical processes for the extraction of the more valuable metals. In the early days of smelting practice, it was often customary to calcine the ore by mixing in heaps with coal and igniting. Expansion of the industry and the legislation concerning the condensation of arsenic and other deleterious fumes has led to improvements in this matter. It is safe to say that the bulk of commercial arsenic products have their origin in the fume from the calcination of various ores.

Calcination of Ores

The most favoured type of plant for the calcination of ore to remove volatile impurities (sulphur and organic matter as well as arsenic) is the rotary kiln set on a slight slope, so that the ore fed in at the top of the furnace can gravitate to the other end, meanwhile being subjected to the heat from the furnace gases which pass through the furnace in a direction opposite to that taken by the ore itself. This counter-current principle leads to a considerable economy in fuel. The condensation of the fume is a matter of some difficulty. It takes a very long time for the particles of arsenic trioxide to settle out; consequently, very long fume-ducts are required, and in some plants the ducts for condensation are arranged along the neighbouring hillsides to the distance of a mile or more. The more up-to-date plants, among which are included the Anaconda copper smelteries, use an electrostatic precipitation plant for the removal of the last traces of fume from the gases. This not

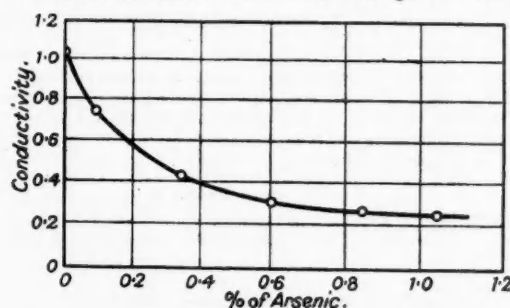


FIG. 1.—EFFECT OF ARSENIC ON THE CONDUCTIVITY OF COPPER.

only increases the yield of fume, but in addition gives an innocuous "tail-gas," which, after the removal of sulphur dioxide, can be allowed to escape.

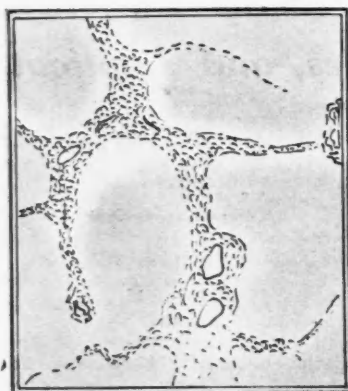
The crude arsenic trioxide which accumulates in the flues is dug out periodically, for which operation the operatives require special protective clothing and masks, since the very fine particles of oxide involve serious risk of poisoning. The product may be used direct for certain purposes where purity is not essential, but for the majority of purposes it is necessary to resublime it. This process is comparatively simple; it is heated in large earthenware pots, holding about a quarter of a ton, surmounted by large sheet iron condensing jackets in which the oxide vapour is deposited. Two sublimations will give a commercially "pure" arsenic trioxide which contains less than 1 per cent. of impurities.

Production of Elementary Arsenic

The production of elementary arsenic cannot be said to present many problems, partly on account of its simplicity, and partly on account of the fact that the substance is not very widely used. It is usually prepared by heating the trioxide with a large excess of anthracite dust. This mixture is placed in steel retorts set slanting in a producer gas-heated furnace. To the end of each retort is attached a long steel tube, inside which is placed a sheath of thin sheet iron. The heating of the re-

torts causes reduction to take place, and the arsenic sublimes into the end of the apparatus and may be withdrawn by removing the iron sheath, to which it adheres as a thick crust. By unrolling the iron sheet the arsenic metal is obtained in the form of thick grey crystalline crusts.

Arsenic occurs as a grey crystalline mass which is very brittle. Its density is 5.7, and it is quite a good conductor of



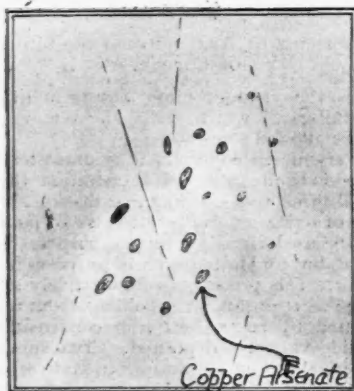
(From Smithell's "Impurities in Metals.")

FIG. 2.—COPPER CONTAINING OXYGEN.

electricity. Its general mechanical properties would tend to class it with the non-metallic elements rather than with the metals, but it has the power of alloying with all sorts of metals. It does not melt when heated under ordinary conditions, since its boiling point is below the melting point. Under pressure it can be obtained molten at 500° C. The principal use of arsenic is for alloying with lead in the manufacture of shot. The addition of about 0.5 per cent. of arsenic to the lead increases the fluidity of the alloy and so improves the shape of the shot, which is, in addition, hardened by the arsenic. Locomotive firebox cases are frequently made from copper containing a small percentage of arsenic.

Arsenic as an Impurity

The effect of arsenic as an impurity in metals is usually very apparent by a change in the mechanical properties of the metal for the worse. The case of copper is of peculiar interest.



(From Smithell's "Impurities in Metals.")

FIG. 3.—EFFECT OF ARSENIC ON COPPER CONTAINING OXYGEN.

The effect of the addition of arsenic has an enormous influence on the conductivity. This is shown graphically in Fig. 1, which indicates the change in conductivity with change in the arsenic content. It will be noticed that as little as 0.05 per cent. of arsenic is sufficient to lower the conductivity by 15 per cent.

On the other hand, the addition of arsenic increases the toughness and counteracts the influence of oxygen (Hanson and Marryat). It reduces the grain size; at 1 per cent. the large columnar crystals of pure copper are replaced by a mass of fine equiaxed crystals, and as the arsenic content increases the intercrystalline form is lost, being replaced by an amorphous structure. The behaviour of arsenic in copper containing oxygen is of particular interest. Fig. 2 shows a specimen of copper containing 0.09 per cent. of oxygen in which the segregation of oxide is very apparent; Fig. 3, which is the same copper containing in addition 0.84 per cent. of arsenic, shows a much stronger structure, the extended structure having been replaced by minute globules of what appears to be copper arsenate. Although the addition of arsenic to copper of this type effects an improvement, it does not always effect improvement in brass. The use of arsenical copper in 70:30 brass does not constitute much of a disadvantage, but with 60:40 brass it reduces the ductility by 50 per cent., owing to the effect it has on the beta-brass. Further, the presence of arsenic in zinc has a tendency to make this metal brittle, and also greatly increases the rate of solution in acids, a fact which is of importance in the production of electric batteries.

The influence of arsenic and one or two other metals on the solubility of zinc in N/2 sulphuric acid is shown in Fig. 4. The importance of this is shown by the recent preparation of a pure sample of zinc in which there is less than one part in 10,000,000 of impurities. This zinc is scarcely soluble in

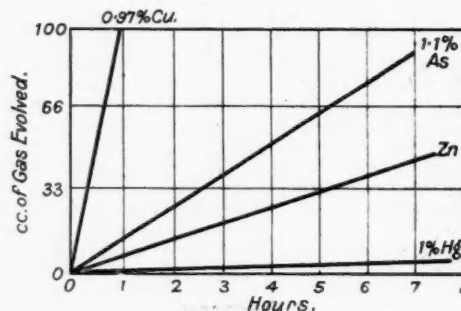


FIG. 4.—INFLUENCE OF ARSENIC, COPPER AND MERCURY ON SOLUBILITY OF ZINC IN N/2 SULPHURIC ACID.

5 per cent. hydrochloric acid, and is dissolved at a rate one thousand times as slow as that exhibited by the co-called chemically pure zinc prepared and sold in connection with the Gutzeit test for arsenic. It appears that the protective powers of such zinc would be very high.

Uses of Arsenic Compounds

Apart from the use of arsenic in medicine, into which it is beyond the scope of this article to go, there is a substantial demand for the trioxide (white arsenic) for various industrial operations; in 1924 the output of the U.S.A. alone totalled 20,177 metric tons, which were utilised in the following ways:—

PURPOSE.	AMOUNT, TONS.
Glass: Decolorisation of Low-grade Glass	2,522
Weed-killer: Domestic and Agricultural	3,026
Paris Green: Insecticide	840
Lead Arsenate: Insecticidal Sprays	2,018
Calcium Arsenate: Boll-weevil Destruction in Cotton Plantations	8,071
Miscellaneous Uses and Stock in Hand	3,700

The above figures indicate that a substantial proportion of arsenicals find their use in the preparation of various forms of agricultural products. So far nothing has been found to supersede arsenical products for the control of the boll-weevil in cotton or the various pests which affect the fruit trees, so that in spite of its poisonous nature arsenic still has an extended field of application in this direction.

The Electrodeposition of Cadmium for Rust Prevention.—(II)

A Paper read before the Electroplaters' Society

The following is the concluding part of a paper (of which the first part appeared last month) read recently before the Electroplaters' and Depositors' Technical Society by Mr. S. Wernick, M.Sc.

AFTER examining the effect of temperature of the solution and current density, the author said that to summarise, the conditions best suited to the attainment of (a) a deposit of small grain size; (b) a solution of optimum conductivity; and (c) a solution of maximum stability, i.e., having electrode efficiency ratio as near as possible to unity, appeared to be as follows:—

Metal Content.—Relatively high concentrations were best; 30 gms./l cadmium content gave good results.

Free Cyanide.—Might vary within fairly wide limits, about 100 per cent. (over the combined cyanide content), giving most favourable results. Appreciable excess beyond this figure markedly affected stability of solution.

Caustic Alkali.—A desirable constituent, 15 to 30 gms./l was a useful range, the upper limit giving superior results.

Temperature.—High temperatures of the solution were best avoided.

Current Density.—10-15 amps./sq. ft. gave the best results.

A solution made up on these lines yielded an electrode efficiency ratio slightly in excess of unity and a high conductivity, the deposit being "structureless" and the condition of the anode satisfactory.

After dealing with the use of addition agents and the throwing power of the solution, the author, referring to the properties of the deposit, said that the superior corrosion-resistance of cadmium deposits as compared with zinc was largely due to its lesser chemical reactivity. It was the ideal protective for ferrous material in so far as it was nearest to it on the anodic side of the electrochemical series, whereas the potential difference between zinc and iron was quite appreciable. While, therefore, the intrinsic protection afforded by zinc was higher than that which cadmium could give, owing to its greater solution pressure, its rate of preferential or sacrificial corrosion was for the same reason also higher. For this reason, a smaller amount of cadmium, or a thinner deposit, provided the protection afforded by a comparatively thick zinc deposit.

Reaction to Chemicals

In regard to the reactivity of zinc as compared with cadmium deposits, tests were carried out in which platings were placed in contact with a number of representative chemicals, the most interesting results being briefly as follows.

In the case of the strong acids, zinc plate was more rapidly attacked, while after the coating had been dissolved, corrosion of the underlying ferrous metal was slower in the case of the cadmium-coated test-piece than that which had been zinc plated. This was possibly due to an alloy formation at the cadmium-base metal junction. Weak acids stripped cadmium plating very slowly, as compared with zinc plating, and the corrosion of the base metal was delayed in proportion.

Alkalies, though more ready in their attack upon zinc plating, caused a considerable darkening and eventual blackening of the cadmium surface, this being more marked with strong than with weak alkalies. Little stripping of the cadmium, however, occurred, while zinc was comparatively rapidly stripped in strongly alkaline solutions and to a considerable extent in mild alkalies.

Ammonia solution discoloured cadmium, which gradually dissolved, this occurring much earlier with zinc plating. Corrosion of the base metal was more rapid in the latter case. Ammonia fumes were markedly corrosive on zinc plating, cadmium plating being practically unaffected by these fumes over extended periods. Ammonium chloride and sodium citrate, examples of salts which readily dissociated in solution with formation of corrosive ions, were more rapid in their action upon zinc plating, there being a marked difference in the extent of the corrosion produced, cadmium plating being easily superior. Benzol, and probably most neutral organic liquids, were without apparent effect over extended periods on either plating.

After giving the result of some corrosion tests on cadmium and zinc plating, Mr. Wernick said that thicker cadmium deposits gave appreciably better protection. A deposit 0.4 mm. thick, for example, as compared with one 0.3 mm.

thick, provided protection considerably in excess of the ratio of these thicknesses. For efficient protection, this thickness, 0.4 mm., was a desirable standard to adopt in commercial work, and it was suggested that the more generally advocated 0.2 mm. deposit be reserved for precision work, etc., where the thicker deposit could not be entertained.

Composite Deposits

The use of cadmium plating as an undercoating to more pleasing finishes of less protective capacity had been suggested, and was actually in use as a standard commercial finish in some plants. Corrosion tests were carried out in particular upon cadmium-plated ferrous material to which both metallic and non-metallic finishes were subsequently applied. Nickel, as expected from theoretical considerations, was far more readily deposited upon a cadmium surface than upon zinc, but the composite deposit was found to be quite inferior to cadmium alone as a corrosion preventive.

A little reflection would indicate the cause. On exposure of the composite cadmium-nickel finish, the cadmium continued to function as a protective by virtue of its own sacrificial corrosion. If it did not, the very purpose for which it was applied would be defeated. At pores in the nickel or other superposed finish, the cadmium accordingly reacted with the corrosive elements to form a cadmium corrosion product. The first stage in the corrosion of the composite plating was the appearance of a white salt at the weakest points in the nickel surface, at the centre of which, after the cadmium was totally "sacrificed," rusting of the underlying ferrous metal invariably occurred. Before rusting, the material presented a decidedly unsightly appearance. In the case of a superposed enamel finish, the same white corrosion product appeared, causing the enamel to flake away, probably because of the increased volume occupied by the cadmium salt.

The thickness of the superposed nickel plating was an important factor prolonging the time before corrosion occurred, the effect no doubt being due to a reduction in porosity, but since this remedy rested upon the efficiency with which the exposure of the cadmium to the atmosphere was prevented, it was obviously of negative value. Underlying nickel with copper showed little or no improvement, while heat treatment of the cadmium after deposition was similarly ineffective.

Mechanical Properties

It was well known that mechanical defects in the deposit had a marked effect upon its protective capacity. One of the defects to which cadmium deposits were particularly prone was blistering. To avoid this, it was important to ensure that the work had a chemically clean surface, and also that cathodic gassing was at a minimum. Relatively high current densities and elimination of preliminary "flashing" favoured the ultimate development of blistering. In the case of the composite cadmium-nickel deposit, Hogaboom suggested that blistering might be due to the oxidation of the underlying cadmium.

The adhesion of a good cadmium deposit was of a high order, no separation of the deposit from the base metal occurring in fracturing in a cupping test or when the plating was bent double. Comparatively thick cadmium deposits showed considerable flexibility and perfect adhesion in twisting, bending and coiling tests, when applied to wire as thin as 0.05 in. diameter. Although cadmium ordinarily became embrittled at 100° C., nevertheless the deposited cadmium did not appear to be greatly affected when subjected to subsequent heat-treatment at this temperature—at least in so far as its flexibility was concerned. Bend tests indicated that there was some tendency to brittleness, but this was not marked.

The composite cadmium-nickel deposit subjected to these tests showed a marked decrease in flexibility, as well as an increase in brittleness, although it was probable that this depended, to a great extent, on the hardness of the deposited nickel. Although no signs of parting of the composite plating occurred in the case of plated sheets under a cupping test, flaking readily occurred when the cadmium-nickel was applied to wires, both in twisting and coiling tests, although it showed up well in the bending test.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Two Notable Anniversaries

THE present year marks the "Diamond Jubilee" of the Iron and Steel Institute, and the "coming-of-age" of the Institute of Metals. The younger Institute has outstripped the membership of the older, but it is to be remembered that for many years the iron and steel trades have been phenomenally depressed and that the developments in ferrous metallurgy have been comparatively few. While blast furnaces have grown hugely in capacity, and steel-making furnaces as well, the introduction of the basic process is the only revolutionary change in iron and steel metallurgy during the past sixty years. Such other progress as has been made has been by way of development. The introduction of "stainless" steel must be shared between ferrous and non-ferrous metallurgy. In the latter, trade has of late been steady and prosperous; not only have practically new metals been developed, but the variety of new alloys has increased and is increasing with bewildering rapidity. Sixty years ago, for example, nickel and aluminium were little more than curiosities.

Both Institutes have furthered immensely the cause of progress, and comparisons based on membership alone would be unfair and invidious. We offer our sincere congratulations to both; may the centenary of the one and the diamond jubilee of the other find them prosperous, progressive and adequately supported by the industries to the scientific promotion of the interests of which they are devoted. They both give far more than they receive, and deserve far more support from those interests than has hitherto been the case.

The Institute of Metals Conversazione

THE Institute of Metals celebrated the occasion by a Conversazione at the Science Museum, London, which was a really notable occasion. The "Age of Alloys" in which we are now living has made the non-ferrous metals not only extraordinarily dependent upon each other but also extraordinarily competitive. The brass and copper man must know all about zinc, of course, but he must know all he can about bismuth and arsenic as well, and as much as he can about nickel and aluminium. No metal nowadays lives to itself alone, but is in close association with many others. The display at the Conversazione served to emphasise this interdependence. Aluminium and its alloys loomed largest, perhaps, of all; and nickel next.

Of the exhibits of a scientific nature, as distinct from those of industrial interest (which were hardly of any less real scientific interest), the specimens shown by Dr. Vernon in connection with his corrosion researches came in for a good deal of attention. They comprised copper "protected" with very thin oxide films, showing, in many cases, the beautiful effect of colour from "interference." Sulphide films were also shown, and shown, moreover, as injurious and liable to promote oxidation. The N.P.L. exhibit comprised pure metals and large single crystals, and the Woolwich Research Department had an interesting display illustrative of the intercrystalline cracking of lead, a subject on which the Department has done much useful work. Mr. Cowper-Coles showed electrodeposited and burnished copper sheets, and spun and stamped electrodeposited metal which possessed, as shown by Erichsen tests, remarkable ductility. The attendance at the Conversazione was over 600, and the function had, it was obvious, attracted a large number of enthusiastic metallurgists and given them something to talk about.

Blast Furnace Practice

IT is gratifying to find a British firm publishing a book, by a British author, of such altogether exceptional merit as "Blast Furnace Practice." The author is Mr. Fred Clements, of the Park Gate Iron and Steel Co., Ltd., and the publishers are Ernest Benn, Ltd. The book is to be in three volumes, of which the first, dealing with general principles and the source, preparation and handling of raw materials, has just appeared (pp. 538, 63s.), leaving the subjects of design of plants and equipment, operation and the utilisation of subsidiary products to be dealt with in the two succeeding volumes, both of which are in the press (the second volume will be out shortly). The book, while exhaustive and minutely detailed,

has the merit of keeping to essentials, which means that out of innumerable data Mr. Clements has selected the best, most up-to-date and most useful, and has avoided the temptation (to which so many authors succumb) of lumbering up his pages with the description of obsolete things or unproven matters of academic rather than of practical utility. He has, moreover, done what no other author has done for the pig iron industry: he has provided a book which deals with every aspect of the subject which experience and judgment have shown to be essential. The chapters on the metallurgical properties of pig iron are very illuminating, and the chemical, thermal and physical principles of blast furnace practice, each of which subjects has a chapter to itself, are complete treatises. The four chapters on the nature, sources and preparation of ores, and those on fluxes, on coke and on the air blast, are similarly exhaustive, and, with a final chapter on the handling and transport of materials to the furnaces, complete the consideration of the raw materials of pig making. Judging from the first volume, the book is the most noteworthy contribution to blast furnace practice ever made, and the subsequent volumes, on the same plan of discriminating selection of all that is best, not in British practice alone, but in that of all pig iron making countries, will be anticipated with the utmost interest by all concerned.

The Origin of Ore Deposits

ALL students of the history of science are aware of the present day tendency to revert to and revive many of the views of ancient and mediæval writers as to the origin and structure of matter. The same tendencies are noticeable in other branches of science. A metallurgist is none the worse for knowing something of the origin of the ores and minerals from which he extracts his metals (as that origin influences greatly the nature of deposits), and of the associated minerals which, as impurities, have to be got rid of in smelting and refining, and hence determine very largely the modes whereby those operations have to be conducted. To the attainment of that object, Dr. Hatch's little book, *Introduction to the Study of Ore Deposits* (Allen and Unwin, 7s. 6d.), will be a great help, as it is written as simply as the rather deterrent nature of the nomenclature of the subject will permit, and conveniently summarises the present state of knowledge as to the origin of ore deposits and their "growth." The curious will detect in his historical summary of the theories of ore genesis the same tendency to revert to the views held even centuries ago (however disguised by the introduction of new terms), rather than to develop and sustain the erroneous opinions held last century. There is little to choose between the juices (*succi*) of Agricola and the "metasomatic alteration products" derived by "magmatic separation" from "intrusives," or the hydrothermal circulation of mineral-bearing solutions. Yet present-day views differ radically from those held, say, fifty years ago.

Do Minerals "Grow"?

AGRICOLA's chief work—although not his chief work on minerals—is available to all in the noble translation by the Hoovers, and the notes with which it is accompanied go far to supplement the lack of a translation of the *De Ortu et Causis* itself. It is astonishing how very generally John Webster's *Metallographia* is neglected: Dr. Hatch does not even mention him. Yet his work of 1671 deals specifically with the causes and manner of the generation of ores, and contains not only his own shrewd remarks, but a wealth of quotations and excerpts from a literature of the subject now sadly depleted by the passing of time, for of many of the authors to whom he refers nothing now remains but their names. If, says Webster, "earth renew itself with salt regenerated; and that bituminous earths have their increase, and stones their growth and augmentation, we may well believe that other Minerals and Metals have the like." And he quotes Sendivogius (*Nov. Lum. Chym. Tract.*, 4, p. 314) to the effect that "From hence it comes to pass that minerals may be found in places where before a thousand years since, there have none been." Metals, he concludes, "do grow even like other vegetables" (the italics are the present writer's), and although the simile may be a forced one, the forcing house of nature, which often adopts the principle of *festina lente*, does, in effect, accomplish

results not wholly incomparable with what Webster elsewhere calls "vegetability," and our modern authors "enrichment," both processes of growth, of which Dr. Hatch remarks that the latter is in all cases probably very slow.

Labour-Saving Metal "Finishes"

IN spite of the fact that iron, steel, copper and brass tarnish all too readily, and that silver—although comparatively a "noble" metal—is subject to the same defect, it is not difficult, when these metals are used for decorative or even ordinary utilitarian purposes, and are in accessible positions, to keep their appearance bright and pleasant. All that is required is the expenditure of a certain amount of time and energy, and some rags and polishing powders. If this were all, the corrosion problem, in its domestic and related aspects, would resolve itself into the minor question of maintaining a minimum of wear and tear from abrasion, for constant polishing entails considerable wear and tear. There used to be housewives to whom the polishing of brass was almost an obsession, but people nowadays simply will not be bothered with the constant cleaning of metal surfaces, and require metals that do not need it. The non-servant-keeping class want, for their household hardware and their motor car fittings, not a metal that can be polished up to look bright, but one which will look bright, or reasonably bright, without the expenditure of energy. Otherwise they resort to paint, varnish and lacquer; to enamelled fittings in bath rooms and lavatories, and to labour-saving kitchen and other utensils that will not require constant polishing to keep them clean. Already there is a revulsion from thin plating which wears off easily, and recourse is had to mat finishes, or to corrosion-resisting alloys of the cupro-nickel or stainless steel type, which keep their surface with no trouble at all.

The Zinc-Nickel Alloys

As the substances mentioned above are relatively expensive, they can be used in thin sheeting only, or a substitute that will really keep bright must be found. It is this which is stimulating so greatly chromium plating, which really does fill the bill. The small car owner has neither the time nor the inclination, once the first flush of his pride of ownership has worn off, to "do" his metal parts up constantly, and the housewife finds her share of cleaning drudgery enough to make her welcome any developments that will spare her labour. Hence chromium plating is growing in favour, for even if it does not last for ever, it has the merit of keeping perfectly bright while it lasts.

It will surprise many people to know that there is a substitute "finish" which in appearance resembles chromium plating so closely as to deceive even a metallurgist, and that this is none other than a zinc alloy of uncertain constitution respecting which a little more knowledge and research would be welcome. It is probably FeZn_{10} . In the well-known "Sherardising" process, iron or steel is coated with zinc by slow heating in a slowly revolving furnace at a comparatively low temperature, in a mixture consisting of zinc dust and other ingredients. The result is an almost complete series of zinc-iron alloys, rich in iron in contact with the iron surface and shading off gradually, as they become richer in zinc and poorer in iron, until the surface consists of practically pure zinc. When this is to a certain extent removed, simply by buffing-off, the underlying alloy presents itself as a hard, bright steely-blue deposit which displays a beautiful mirror-like polish, and, being an integral substance with the alloy and the metal beneath, does not peel or flake off. Just how long it maintains its polish in adverse conditions it is not easy to say, for the specimens seen by the writer were only a few months old; up to now they have shown no signs whatever of any tarnish, bloom, or corrosion. The zinc-iron alloys are, of course, anodic to iron, and should therefore be, so to speak, sacrificial substances, but hitherto the sacrifices they have been called upon to sustain do not appear to have affected them at all.

Research Fellowship in Metallurgy

THE Secretaries of the Royal Society invite applications for the Armourers and Brasiers' Company Research Fellowship in Metallurgy. The successful candidate will be required to enter upon and devote his whole time to a course of research which must be connected with base metals and alloys, and preferentially those used in connection with the Ancient

Crafts of the Company of Armourers and Brasiers. The research is to be carried out under the scheme approved by the Royal Society and the Armourers and Brasiers' Company, particulars of which can be obtained from the Royal Society. The appointment will be for two years in the first instance but may subsequently be extended to a maximum of five years. The stipend will be £500 per annum, dating from the commencement of the research. In making an award the committee will not regard the object of the Fellowship as being to train men for original research, but rather to give to men who have already proved their ability in research an opportunity to obtain valuable advances in the science of metallurgy or the kindred sciences. Applications must be received at the Royal Society, Burlington House, London, W.1, not later than May 31. Applicants must give three references and furnish particulars of their academic qualifications and of the research work already carried out by them.

The English Steel Corporation

THE Vickers, Vickers-Armstrong, and Cammell Laird steel combine was recently registered as a public company under the title of the English Steel Corporation, Ltd., with a nominal capital of £8,000,000 in £1 shares (£2,000,000 7 per cent. cumulative preference and £6,000,000 ordinary). The objects are to acquire from Vickers, Ltd., Vickers-Armstrong, Ltd., and Cammell Laird and Co., Ltd., certain parts of their respective businesses and assets (especially their steel businesses). Powers are taken to carry on all kinds of engineering business and the businesses of iron masters and founders, steel makers and converters, colliery proprietors, coke manufacturers, machinists, manufacturers of armour plate and bullet-proof plates, smelters, miners, tinplate makers, manufacturers of agricultural implements and other machinery, iron and steel converters, and various other businesses. The memorandum of association contains a proviso, however, that the company may not manufacture or sell armaments (as defined in the memorandum) except as agents for or sub-contractors to Vickers-Armstrongs, Ltd. and/or Cammell Laird and Co., Ltd., or their respective successors in business, and that the company may not build ships constructed with the intention of carrying more than 12 passengers and of a greater length than approximately 550 feet.

Liquid Shrinkage of Alloys

THE American Foundrymen's Association has established a research associateship at the United States Bureau of Mines for the study of methods of determining the liquid shrinkage of alloys. The soundness of a casting depends, among other things, on its freedom from concealed piping or internal voids due to shrinkage, from trapped gas bubbles, and from shrinkage cracks. Three main factors are concerned in respect to the metal itself, as distinguished from the foundry practice, in securing freedom from these defects, i.e., fluidity, liquid shrinkage or change of volume between the liquid and the solid state, and solid shrinkage or change of volume between the freezing point and room temperature. Methods for the determination of the last property, solid shrinkage, are in fairly satisfactory shape, but as yet those for the first two are not. The subject is of especial importance in the case of cast iron, where the amount of liquid shrinkage seems to have a bearing on the suitability of different compositions of cast iron for different uses.

A Remarkable Tinning Compound

A TINNING compound having a number of very valuable properties is being marketed, under the name "Soldo," by The Soldo Co., of Sicilian House, Southampton Row, London, W.C.1. Soldo, which is non-acid, consists of a powder containing a combination of fluxes and metal and is free from both lead and mercury. All metals, except aluminium and low-grade cast iron, whether rusty, corroded, greasy, painted or enamelled, with no previous preparation whatever, beyond the application of heat and Soldo alone, can be permanently and effectively tinned. All time and labour involved in preparatory cleaning is thus done away with.

The claims of the makers are borne out by a report by the National Physical Laboratory on some tests carried out on Soldo. The concluding paragraphs of this report (which may be obtained from the Soldo Co.) lay stress on the power shown by Soldo to deal with rusty or dirty surfaces and its interpenetration into the metals used.

Trade, Commerce, Finance : The Month in Review

From Our Market Correspondent

THROUGHOUT the month of March the iron and steel market has maintained a firm tone, and there has been a steady flow of business. We have reached the first seasonal disturbance, in the Easter holidays, with which the month and the first quarter of the year close, but its effect on the trade is not very marked; indeed, some of the works are carrying on right through the holiday.

There is a general expectation of a further revival in trade after Easter, but before many weeks have passed there will be all the upset of the General Election, and that is certain to put a temporary check on business activity. Moreover, the uncertainty as to which party will be next in power may have a restraining influence.

An Improvement

As far as the volume of orders is concerned, there is a decided improvement as compared with the latter part of the year 1928. Of course, all the steel works are not equally favoured in this respect. Some are fortunate enough to be working at full output, whereas others are practically dependent on each morning's post for the orders to carry them through the day; but, generally speaking, the mills are fairly well occupied.

The demand for steel for shipbuilding and for engineering is good, although here also it is necessary to point out that the demand is not evenly distributed over all the various products. For instance, steel plate specifications are still eagerly sought after by most of the large capacity plants which require large tonnages of ordinary quality plates to keep them going. It must be generally known that there is not the least likelihood of sufficient plate orders being forthcoming to satisfy all the mills, and, that being so, there will always be a scramble for orders, with the cutting of prices as far as is possible without infringing the Association's regulations. The special qualities of steel plates which should legitimately carry an extra over the ordinary price are suffering from this competition.

Again, the business in large sections is rather quiet just now, and reports from several of the chief producers show that the order books for this particular class of steel are very lean. On the other hand, small sections are quite a good market, and the small steel bar trade is also very brisk. For sections there is no competition, the price being officially fixed, but small bars under 3 in. round and flats 5 in. and under are free and makers can quote what they like. That explains the wide range of prices, some makers quoting as low as £8, or even slightly less, while others are nearer £9. Certainly, for the better qualities of bars for bright drawing and similar purposes the demand is exceptionally brisk and good prices are obtainable. The motor car trade largely accounts for this, and so long as that continues as active as it is at present there will be no falling off in the demand for small bars.

The Re-Rolling Trade

The re-rollers are quite busy, and have endeavoured to advance their prices almost to the level of the steel makers', but they have had to give way, although they are not much below the steel works prices. Continental competition in this steel is not affecting the market nearly so much as formerly. Semi-finished steel has also shown considerable improvement. Prices have been advanced and makers seem to be booked well ahead. There is very little attraction in Continental offers of semis, as the price is not much below ours, and the time of delivery is very uncertain, so that consumers prefer to place their orders with the English works on whom they can rely for quality and delivery.

Financial Aspects

That is the position as it relates to the amount of business which is being done. The monetary side of it is not so favourable. In the last report the adverse conditions under which the steel makers were labouring, with controlled prices remaining at their old level and costs of production steadily increasing, were pointed out. That position is no easier. Steel scrap is

still a scarcity, and the top price has not yet been reached. All the steel-producing centres are clamouring for supplies, and each fresh contract booked is at a higher price. Some of the works have already turned to the remedy which was mentioned last month, and have largely reduced the percentage of scrap used, whilst increasing the percentage of pig iron. If they make their own pig iron they are finding the cost moving upwards.

Blast furnace coke is almost as scarce as scrap, and the coke makers are taking advantage of this to put up their price for every new contract. In those cases where the steel makers have to buy their pig iron, they are paying several shillings a ton more for it than at the end of last year. It is doubtful, too, whether largely increased supplies will be available, owing to this difficulty of obtaining coke. One blast furnace in the Midlands has just been blown out because of this shortage, and others may have to follow suit. This is the outcome of the coal control scheme, which has reduced the supply of coking slack, and one can see little prospect of an improvement.

Shortage of Scrap and Coke

These two factors, then, the shortage of scrap and of coke, are working against the steel makers, as they are getting no more for the controlled portion of their output, that is steel plates and sections, than when the price of scrap was 15s. per ton less and coke 2s. per ton less than to-day. Everyone is agreed that there ought to be an advance in the official prices, but apparently there are reasons why such a move cannot be made just now. There is to be a joint meeting of the Associations in the middle of April, and the result will be awaited with much interest.

The expectation of an advance in price is general, as is shown by the large amount of forward buying that is taking place. Consumers everywhere are seeking to make contracts with the steel makers to cover their requirements for some months ahead at the present prices, and while some makers are moving warily and limiting the quantity, others are taking all that is offered. The result will be that even if the official prices are advanced, most of the makers will find themselves committed to supplies at the old prices over a considerable period. These are lean enough in all conscience; indeed, with the increase in cost which has taken place during this first quarter of the year they must mean a severe loss in many cases. One is bound to emphasise the note of warning not to place too much reliance on the reports of a general improvement in the steel trade. It is no use taking quantity alone, and when prices and costs are considered in conjunction with the volume of trade it is difficult to see where the justification lies for undue optimism.

Pig Iron

The pig iron market has maintained its firmness, and there is a feeling of confidence which indicates that the worst has been passed. An agreement for the stabilisation of prices for foundry iron has been reached between the Derbyshire, Northamptonshire and Staffordshire makers, and minimum prices have been fixed for the various qualities. This is a step in the right direction, as it will put an end to the price-cutting which has been spoiling this trade. The Cleveland makers are also working for a similar object. There is a good demand in that district, and practically the whole of the production is going for sale. Prices are firm, and while the makers are willing to book contracts for supplies up to the end of June at present prices, they are asking 1s. 6d. advance for longer deliveries. Hematite is sharing in the improvement, prices having steadily advanced 3s. or 4s. above the level ruling at the end of last year. The demand is good and stocks are negligible. It is expected that there will shortly be an increase in the output, although the trouble in getting coke may retard this.

The production of pig iron in February amounted to 519,600 tons, as compared with 563,900 tons in January, there being an addition of one to the number of furnaces working. The output of steel was 782,900 tons, compared with 764,600 tons in January.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature, published weekly in THE CHEMICAL AGE.

Alloys

COPPER-SILICON alloys adapted to be rolled, presed, stretched, or otherwise worked, and also suitable for making castings are described in Specification 303,684 (Mond), dated February 29, 1928, a communication from Metallbank und Metallurgische Ges. Akt.-Ges., of Frankfort-on-Main, Germany. They contain 1 to 4 per cent. of silicon, 1 to 5 per cent. of nickel, and 4 to 6 per cent. of iron. Tin (up to 1 per cent.) may be added to improve the distribution of the iron. Manganese (up to 1 per cent.) increases the tenacity. Aluminium (up to 1 per cent.) imparts a smooth surface to the castings. Up to 20 per cent. of the copper may be replaced by zinc. The tenacity of the alloys is improved by heating to 750–950° C., quenching, and further heating to 350–600° C., and such improvement is greater if there is present in the alloy from 0.001 to 0.5 per cent. of an alkali metal or an alkaline earth metal.

THE physical properties of corrosion-resisting iron-copper-molybdenum alloys, substantially free from chromium or nickel and containing at least 95 per cent. of iron, are improved by adding small amounts of manganese, preferably in the form of a ferro-manganese of low carbon content, to the molten alloys. The products are adapted for subjection to piercing, cold drawing, and like mechanical operations involving tensile stresses, without impairing thereby the corrosion-resisting qualities or injuring the surface or internal structure of the worked article. Products with improved surfaces are obtained by adding some silicon or silicon and aluminium with the manganese. See Specification 306,320, dated April 13, 1928, by H. L. Miller, of Canton, Ohio, U.S.A.

STEEL alloys resistant to scaling up to 800° C. are described in Patent Application 304,303, bearing the International Convention date January 19, 1928, by H. J. Schiffer, of Dusseldorf, Germany. They contain 1–4 per cent. of aluminium, with or without one or more other metals such as manganese, chromium, tungsten, molybdenum, titanium, or vanadium, and may be annealed at 750–950° C., and quenched, with or without subsequent re-heating to 500–750° C.

Aluminium

IN the electrolytic or electro-thermal production of aluminium or its alloys, compounds comprising two or more alkali metals are employed. The metal or alloy so obtained is stated to differ in properties from that similarly obtained with reagents comprising only one alkali metal. Thus, alumina produced from sodium aluminate may be electrolysed with a flux comprising the double fluoride of potassium and aluminium, or alumina from potassium aluminate may be electrolysed with a cryolite flux. Similar metal or alloy may be obtained by mixing the product obtained by using a sodium compound as initial material and as flux with the product obtained by using potassium compounds only. See Patent Application 303,755, bearing the International Convention date January 7, 1928, by A. Pacz, of Cleveland, Ohio, U.S.A.

Chromium Plating

CHROMIUM is deposited from an electrolyte consisting of sodium bichromate, chromic acid, and chromic fluoborate, with or without a small quantity of fluoboric acid. The anodes may be of lead or chromium. See Patent Application 303,884, bearing the International Convention date January 12, 1928, by Soc. Nouvelle de l'Orfèvrerie, of Paris.

Iron

A PROCESS for purifying iron powder by a heat treatment to obtain a product suitable for use in iron cores of electromagnetic apparatus is described in Specification 306,215 (Johnson), dated December 2, 1927, a communication from I.G. Farbenindustrie Akt.-Ges., of Frankfort-on-Main, Germany. To avoid undesirable sintering, the treatment is effected in two stages. The iron powder is first treated at about or somewhat below 500° C. with a reducing gas free from carbon, e.g., hydrogen or ammonia, until the carbon content is not more than 0.5 per cent., and thereafter, with or without intermediate cooling, heated to above 500° C., but

below its melting point in the same gas or in an inert gas such as nitrogen. The product is then ground to the required degree. A suitable initial material is an iron powder obtained by the thermal decomposition of iron carbonyl.

A PROCESS and apparatus for the solid reduction of iron ores—i.e., reduction without any melting or sintering of the materials, are described and illustrated in detail in Specification 306,561, dated August 18, 1927, by J. W. Hornsey, of New York. The ore is passed through a rotary preheating cylinder and discharged therefrom into a rotary reducing cylinder, to which a reducing agent is supplied, and which is heated by the combustion therein of fuel and air introduced at the discharge end under such conditions that the air does not come into detrimental contact with the material being reduced. Preferably a stream of reducing agent in the form of powdered coal is delivered into the ore-receiving end of the reducing cylinder by a screw conveyor provided with a chute feed regulator to prevent clogging, and water-jacketed to prevent detrimental preheating. At the other end of the cylinder the air is supplied under pressure centrally of a nozzle delivering solid fuel, thus providing a flame with a non-oxidising peripheral zone extending along the reducing chamber in a direction opposed to that of the movement of the preheated ore and its reducing agent.

Platinum

A PROCESS for extracting metals of the platinum group from ores and residues containing them in association with nickel, copper and iron is described in Specification 306,566, dated October 21, 1927, by S. C. Smith, of London. A sulphide matte is first produced in known manner. This matte, with or without a preliminary bessemerising operation, is then desulphurised by roasting, and the roasted matte reduced to produce a metal sponge. Nickel and iron are then extracted from the sponge by treatment with dilute acid, leaving a residue suitable for electrolytic refining, comprising the platinum metals in admixture with copper. In some cases the roasted matte is subjected to a preliminary leaching with acid, e.g., sulphuric acid, to remove the bulk of the copper. The process is applicable to the residue from the operation of leaching unroasted ferruginous matte with acid as described in Specification 296,744 (see THE CHEMICAL AGE, Vol. XIX, p. 45 [Metallurgical Section]).

Treating Matte

THE efficiency of the leaching of a copper-nickel matte, e.g., with sulphuric acid, to dissolve the nickel, is increased by a preliminary rapid cooling of the matte, as by granulation in water. Alternatively or additionally, some iron sulphide (2 to 10 per cent.) may be left in the matte during its customary treatment in a converter. The leaching may be effected at 80–100° C. on the countercurrent principle. The nickel sulphate may be crystallised out after removal of the iron, and the nickel obtained from it by heating to 800–900° C. and reducing the oxide so produced. Alternatively the nickel may be obtained electrolytically from the nickel sulphate solution. The residue, comprising sulphides of copper and precious metals, including gold, silver, platinum, palladium, iridium, rhodium, ruthenium, and osmium, may be blown in a converter, the copper being thereafter refined electrolytically, and the precious metals being obtained as a concentrate from the anode residues. See Patent Application 303,066, bearing the International Convention date, December 27, 1927, by F. E. Lathe, of Ottawa, Canada.

Zinc

IN a process for obtaining zinc and similar volatile metals from their ores, described in Specification 306,425, dated September 14, 1927, by H. E. Coley, of London, the vapours from the reducing chamber are passed directly into a chamber cooled, preferably artificially, where the metallic vapours are condensed and separated from the other gases by causing them to ascend through a fine spray of water, paraffin, or other suitable liquid. This liquid serves also to transfer the separated metal to a filter press or other filtering device. The reducing chamber is preferably of the rotary tube type described in Specification 281,129, the reduction being effected by heating the ore to its reducing temperature and, by means of a water-cooled pipe or conveyor, introducing a liquid or solid hydrocarbon in such a way as to produce nascent carbon at the surface of the ore as described in Specification 215,400.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—The structure of copper-tin alloys. W. Broniewski and B. Hackiewicz. *Revue de Métallurgie*, January, pp. 20-28 (in French). The second and closing portion of an article of which the first part (by W. Broniewski) appeared in the same journal in 1915, p. 961.

Hardness and magnetic properties of iron-copper alloys and their connections with the phase diagram. A. Kussman and B. Scharnow. *Zeitschrift anorganische Chem.*, Vol. 178, Parts 1-3, pp. 317-324 (in German).

ANALYSIS.—Determination of chromium, tungsten, molybdenum, vanadium, nickel, manganese, and cobalt in highly alloyed steels. H. Mende. *Chemiker-Zeitung*, March 2, pp. 178-179 (in German).

The determination of aluminium in steels. A. T. Etheridge. *Analyst*, March, pp. 141-144.

The determination of silicon in ferrosilicon and other ferro-alloys. A. Stadeler. *Stahl und Eisen*, March 7, pp. 325-326 (in German).

COPPER.—The copper-copper oxide eutectic in copper refining practice. W. Stahl. *Chemiker-Zeitung*, February 16, p. 137 (in German).

CORROSION.—The corrosion of brass. M. Haas. *Korrosion und Metallschutz*, February, pp. 25-35 (in German).

The reduction of the attacking action of alkaline solutions on aluminium by the addition of colloids. H. Röhrig. *Korrosion und Metallschutz*, February, pp. 41-43 (in German).

Methods of testing for the valuation of the resistance of metals to corrosion by weather and sea-water. E. Rackwitz and E. K. O. Schmidt. *Korrosion und Metallschutz*, January, pp. 7-13 (in German).

ELECTROLYTIC PRECIPITATION.—Investigations on the electrolytic precipitation of metals. K. Arndt. *Berichte Deutsche Chem. Gesellschaft*, January 9, pp. 80-84 (in German).

The theory of the electrolytic separation of chromium from aqueous solutions of chromic acid. E. Müller and P. Ekwall. *Zeitschrift Elektrochem*, February, pp. 84-89 (in German).

GENERAL.—The technical significance of gases in metals. E. H. Schulz. *Zeitschrift Metallkunde*, January, pp. 7-11 (in German).

The technical properties of vacuum-molten metals. W. Rohn. *Zeitschrift Metallkunde*, January, pp. 12-18 (in German).

The absorption of gases by metals. A. Sieverts. *Zeitschrift Metallkunde*, February, pp. 37-46 (in German). The capacity of metals and alloys for dissolving oxygen, nitrogen, the inert gases, sulphur dioxide, and hydrogen is discussed. Tables of solubility are given.

The investigation of gases in metals. W. Hessenbruch. *Zeitschrift Metallkunde*, February, pp. 46-57 (in German). The significance of impurities, manner of combination of gas and metal, method of gas determination, and description of suitable apparatus; some experimental results are also given.

The annealing of metals *in vacuo*. L. Guillet and A. Roux. *Revue de Métallurgie*, January, pp. 1-11 (in French).

Heat treatment and testing of high speed steel tools. F. Rapatz. *Stahl und Eisen*, February 21, pp. 250-255 (in German).

MECHANICAL PROPERTIES.—The conjugated influence of velocity of deformation and of temperature on cold-hardening. A. Roux and J. Cournot. *Comptes Rendus*, February 25, pp. 631-633 (in French).

PASSIVITY.—The experimental foundations of the theory of passivity. W. J. Müller. *Zeitschrift Elektrochem.*, February, pp. 93-94. J. Hinnüber. *Ibid.*, p. 95 (in German).

PLANT.—The construction of technical apparatus for electrolysis in the molten state. P. Droszbach. *Metall und Erz*, Vol. 25, Part 4, pp. 88-92 (in German).

PLATINUM.—Some physical properties of platinum. A. T. Grigorjew. *Zeitschrift anorganische Chem.*, Vol. 178, Parts 1-3, pp. 213-218 (in German).

STAINLESS IRON.—Stainless iron and its application to the manufacture and transportation of nitric acid. W. M. Mitchell. *Trans. Amer. Soc. Steel Treating*, February, pp. 303-338. Deals with the use of stainless iron for plant for the catalytic oxidation of ammonia to nitric acid and for drums, cars, etc., for the transport of the latter. The superiority of high chromium alloys in resistance towards nitric acid is described. Existing specifications for plates, rivets, tubing, castings, tank cars, shipping drums, etc., are critically discussed.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

BALDWINS, LTD., London, E.C., coal and iron masters.—Registered February 20, series of £471,000, income notes, created pursuant to a Scheme of Arrangement sanctioned by Order of Court dated July 30, 1928, etc., present issue £399,000; general charge (subject, etc.). *£2,649,100. December 14, 1927.

MIDLAND COAL, COKE AND IRON CO., LTD., Newcastle (Staffs).—Registered February 19, Trust Deed dated February 1, 1929, securing £100,000 prior lien debentures (in addition to £300,000 secured by Trust Deeds dated July 7, 1919, and March 2, 1928), limited to a present issue of £30,000; charged on property comprised in Trust Deed of July 7, 1919, etc. *£591,044. March 1, 1928.

PARK FOUNDRY (BELPER), LTD.—Registered March 5, £30,500 balance of £40,000; general charge.

PEARSON AND DORMAN LONG, LTD., London, S.W., colliery proprietors, etc.—Registered March 15, mortgage (supplemental to Trust Deed dated April 13, 1926, securing £2,000,000 5 per cent. guaranteed debenture stock); charged on land comprised in conveyance dated April 27, 1926. *£2,000,000. May 31, 1928.

SHEEPBRIDGE COAL AND IRON CO., LTD., Chesterfield.—Registered February 13, £2,950 debentures, part of £750,000; general charge (except uncalled capital and certain property). *£572,800. October 8, 1928.

MATTHIAS SPENCER AND SONS, LTD., Sheffield, steel manufacturers.—Registered March 8, £5,000 debentures; charged on Albion Steel Works, Sheffield, also general charge.

UNITED STEEL COMPANIES, LTD., Sheffield.—Registered March 15, £3,412 10s. mortgage to Major C. E. A. Milburne, Burton Rough, Petworth, and another; charged on lands at Orgreave, etc. *£2,332,398 debenture stock, £362,501 mortgages. November 5, 1928.

Satisfactions

FRODINGHAM IRON AND STEEL CO., LTD.—Satisfactions registered February 20, £40,000, part of £800,000, registered October 12, 1917, and £7,495, part of £149,900 registered June 20, 1925.

GLAMORGAN HEMATITE IRON ORE CO., LTD., Cardiff.—Satisfaction registered March 12, £9,805, balance of £29,415, total issued of amount registered July 6, 1921.

NORTH HENDRE LEAD MINING CO., LTD., Chester.—Satisfaction registered March 8, £2,500 (not ex.), registered November 25, 1918.

Monthly Metallurgical Section

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NOTICE.—Communications relating to editorial matter for our Monthly Metallurgical Section should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

Metallurgy at the National Physical Laboratory

Report for the Year 1928

The report of the National Physical Laboratory for the year 1928 has just been published (H.M. Stationery Office, pp. 283, 9s.). A resumé of the more important points in the report appears below.

ONE direction in which research at the N.P.L. has been prosecuted for years past is the preparation of pure metals. Lately, attention has been confined to the production of considerable quantities of iron and chromium of high purity, needed for research on the alloys of iron. This work has been greatly facilitated by the use of a newly installed valve-operated high-frequency induction furnace. The purification of iron and chromium, particularly as regards oxygen, has presented a number of important problems. The oxide content of electro-deposited chromium has been reduced from a value ranging from 2 to 1.4 per cent. down to 0.05-0.01 per cent., while all traces of oxide visible under the microscope have been removed from electro-deposited iron by heating the liquid metal in a stream of hydrogen.

With regard to the behaviour of metals and alloys under strain, attention has been devoted to the apparatus for the calorimetric determination of the heat generated by wire drawing, for the purpose of determining the amount of heat which becomes latent when a metal is subjected to severe plastic deformation in the cold. The study of the physical structure of metals and alloys, by means of X-rays and otherwise, has been continued.

Single Crystals

A considerable number of single crystals of various metals have been produced having diameters up to $1\frac{1}{2}$ in. The crystals have all been formed by the Bridgman process of very slow solidification of a vertical cylinder of the molten metal from the bottom upwards. Crystals of copper, zinc and antimony have been utilised in research on the mechanism of deformation, and crystals of bismuth are being used in the Physics Department for the measurement of the influence of a magnetic field on thermal conductivity. Crystals of cadmium have also been produced for future use. It has further been found possible to produce in the same manner single crystals of solid solutions of gold and silver.

In spite of the success which has attended the preparation of these crystals, a completely satisfactory theory of the process is not yet available. It is hoped, by varying the conditions of the preparation, to gain more precise knowledge of the circumstances determining the formation of single crystals by direct solidification of molten metal. For this purpose a special type of thermostat for controlling the temperature of the furnace used in the preparation of single crystals has been developed.

Light Alloys and Minor Metals

Further researches on aluminium alloys and also, to a small extent, on magnesium alloys have been carried out, the alloys chosen being those of aluminium with barium and thorium (and the influence on them of silicon) and those of magnesium with aluminium and copper. A report on the mechanical properties of "Elektron" alloy as supplied commercially has been presented to the alloys sub-committee. In the minor metals section, work has been done on the production of pure beryllium, on the comparative properties of cadmium-zinc and tin-lead solders, and on the production of metallic titanium.

Alloys for Use at High Temperatures

Research on alloys for use at high temperatures has been continued under the auspices of the committee on the behaviour of materials at high temperatures. The work has consisted of two main sections; the first of these is the continuation of the work described in last year's report. This relates to the

preparation and the study of the high-temperature properties of a series of alloys consisting of nickel-chromium and nickel-chromium-iron, and of the derivatives obtained from these by the addition of a number of other elements. The second section relates to the study of the mode of deformation, flow and fracture of metals at high temperatures under prolonged load, which may be briefly termed the investigation of "the mechanism of creep."

In regard to the first portion of the programme, the work has largely consisted in the preparation of alloys for the purpose of mechanical tests at high temperatures. In addition, the properties and constitution of the more complex nickel-chromium alloys containing additions such as iron, carbon, manganese, silicon, tungsten, molybdenum, vanadium and titanium have been the subject of extensive study; in some cases the alloys examined have contained as many as four of the additional constituents above named. A large number of cast and rolled bars have been prepared from the alloys included in the above list, and the majority of these have been tested.

Commercial Possibilities

The results indicate that considerable progress in the commercial development of alloys of this type is probable. As an example, one of the special casting alloys developed in the Laboratory has now given, under a stress of 8 tons per sq. in., a life of 15 days at a temperature of 800° C. before the occurrence of rupture. This constitutes a marked improvement on the results obtained with previously existing materials, the best of which, according to the tests so far carried out, withstood only 5 tons per sq. in. for a similar length of life at 800° C. That still further development is possible is indicated by the fact that four other types of alloy have also given promising results.

Considerable attention has been given to the study of the constitution of the alloys of nickel and chromium, and of the ternary system nickel-chromium-iron. The exact determination of the liquidus temperatures (freezing points) of these alloys has proved of considerable value in guiding manipulation in the production of castings.

The Mechanism of Creep

In regard to the second portion of the work, relating to the study of the fundamental question of the mechanism of creep, it has as yet been possible to make only a beginning. The method of attacking the problem which has been adopted is that of studying microscopically the mode of deformation and fracture of specimens of various metals when exposed to prolonged stress at high temperatures.

In order to allow of microscopic examination and to make it possible to follow in detail the process of deformation and rupture, the surfaces of the test-pieces must be polished before they are placed in the straining apparatus, and must be examined at intervals during the straining process. For this purpose it is necessary that the surfaces shall be protected from oxidation, and the method adopted is the use of a high vacuum, although in certain cases a neutral gas atmosphere will prove preferable owing to the volatility of some metals when heated *in vacuo*.

For the purposes of this research an apparatus consisting of what may be described as "creep units" has been designed and is approaching completion. Each unit consists of suitable gear for applying a load, by means of a weight and a lever, to a test-piece which is held in a vertical position in a suitably

arranged electric furnace. In order to secure the protection of the specimen by a high vacuum, the test-piece itself will be enclosed in a long tube of vitreous silica, dipping at the bottom into mercury and communicating at the top with powerful exhausting pumps. The barometric mercury column which rises in the silica tube under these conditions serves as a vacuum seal which imposes no friction on the actual testing mechanism of the apparatus. Each of the three units has been constructed to take specimens up to 0.75 in. in diameter. Loads can be applied by lever arms to the shackles, so that any value up to a total of 1 ton can be used with each specimen. If high unit stresses are required the cross-section of the specimen can be suitably reduced. The apparatus is arranged so that it can be used for temperatures up to 1300° C., but it is anticipated that the greater part of the work will be done at temperatures not exceeding 800° C.

It is realised that the exact mode of distribution of the various constituents of an alloy materially affects the behaviour of the metal under prolonged load at high temperatures. It is therefore anticipated that the microscopic study of creep will prove of considerable importance in guiding the further improvement of alloys intended for use at high temperatures, and that it will also throw light upon the general mechanism of creep and creep failure.

Miscellaneous Research

Attention has been paid to gases in steel, and to the systems iron-silicon, iron-beryllium, iron-manganese and iron-

chromium. The extensive ramifications of metallurgy are shown by the fact that, at the instance of the Dental Investigation Committee of the Department of Scientific and Industrial Research, the constitution and properties of dental amalgams are being explored. For this purpose a knowledge of the ternary system tin-silver-mercury is required, and the problem has been attacked in the first place by a study of the three constituent binary systems, silver-tin, tin-mercury, and silver-mercury. The investigation of the silver-tin system was completed some time ago, and progress is being made with the other two.

The National Physical Laboratory also does work in conjunction with the research associations, and mention may be made of two investigations, dealing respectively with impurities in copper and the die-casting of aluminium alloys, carried out for the British Non-Ferrous Metals Research Association.

A point of some interest arises in connection with the atomic hydrogen blow-pipe. A great deal was said about this apparatus some time ago, but lately little has been heard of it. It is stated in the report now under review that one of these blow-pipes was presented to the National Physical Laboratory by the General Electric Co. of America, and use was made of it in an attempt to prepare pure beryllium. The attempt was apparently abortive. Preliminary experiments with copper showed that melting the metal under the atomic hydrogen flame rapidly reduced the oxygen content, although the copper became saturated with hydrogen.

The Control of the Claudet Silver Process

(From a Correspondent)

To maintain the efficient control of a process such as the Claudet method of silver extraction and iodine recovery, it is necessary to introduce a system of analysis which will record with accuracy the progress of each stage. The importance of this will be more fully realised when it is remembered that during the war the price of iodine soared very high indeed. Any slackness in the manipulation of the process is apt to cause a loss of silver on the one hand, or a loss of iodine on the other. From this it will be observed that unless the system of analysis is conducted with great thoroughness, the losses incurred will be too heavy to permit of such a process being carried on economically. The following description gives a concise detailed outline of the methods adopted.

Determinations Required

The liquor treated for silver extraction consists primarily of copper sulphate and chloride from the roasting of burnt pyrites with salt. Prior to reaching the silver department the liquors are allowed to cool in settling tanks so that lead sulphate and chloride are given an opportunity to separate out, together with any mechanically held iron ore. The tanks are constructed of wood, with an inner lining of glazed slabs.

The settled liquor is next led to a large well or sump which holds a definite volume. After being well mixed, the temperature and density of the liquor are ascertained, and a sample taken for analysis. The analyses consist of acidity and degree of oxidation of the liquor, together with an assay of the silver content. When the density falls to an abnormally low figure, a determination of total copper is also made. As the liquor is strongly acid and rich in copper, little satisfaction could be gained by titrating it with normal alkali with a view to ascertaining the acidity. A 10 per cent. solution of ammonium hydrate in water is sufficient to provide a good comparative indication of the extent of the acidity. The titration is conducted directly on a measured portion of the liquor.

Oxidation is determined by a direct titration with standard potassium permanganate. When it is necessary to determine copper, this is done by means of the sulphuretted hydrogen and subsequent electrolytic method. Silver is assayed in a half gallon of the liquor, which is treated with iodide in a similar manner to that adopted in the process. That is, if sodium or zinc iodide respectively are used on the large scale the same conditions should be adhered to with regard to the analysis. The precipitated silver is fused in a fireclay crucible with litharge and flux, and the lead button cupelled in the usual manner.

Difficulties Due to Impurities

Various wet estimations have been proposed which were expected to surpass the dry assay, but so far no other really reliable rapid method has been divulged. The presence of the many impurities usually to be found in poor copper ores is largely responsible for the difficulty experienced of quickly getting rid of them, and rapidly determining silver by application of one of the approved volumetric methods.

From the weight of silver obtained, the amount of iodide required to precipitate silver in the tanks is calculated. A five per cent. excess of iodide is added to ensure as complete a precipitation of the silver as possible. This is the maximum excess which should be allowed, as it is not possible to recover economically all the silver without incurring an unwarranted loss of iodide in the liquor, which cannot be reclaimed. Should any inaccuracy in the silver assay result in an insufficient amount of iodide being employed at the tanks, the loss of silver sustained is, of course, serious.

Actual Application to the Process

The liquor from the sump is raised by means of steam jacks or pumps to tanks on the staging overhead. This pumping in contact with the steam warms the liquor, and makes it more suitable for treatment with precipitants. Either sodium or zinc iodide is employed. The iodide solution is measured from graduated boxes into a small lead-lined tank containing a known proportion of water, after which the whole is run directly into the liquor tanks. Strong solutions of iodide cannot be used, as these might result in part of the copper being deposited in place of the silver, and hence a portion of the latter metal would remain unprecipitated. If the untreated liquor has not been allowed to settle sufficiently to allow all the lead to separate out, part of the iodide will be used up to precipitate it. The five per cent. excess is expected to meet this contingency.

After settling, the clear liquor is filtered free from suspended particles and passed on to the copper-precipitating department. This filtered liquor is sampled and examined for silver and also for excess of iodide. If the silver content is high (say, over 0.2 grains per gallon) the liquor should be examined for insoluble silver, as the fault may lie in the manner in which the filter has been used. Should an appreciable amount of silver be present in solution, it is then necessary to increase the amount of iodide. Too short a period of settling of the iodide-treated solution is often responsible for losses.

The excess of iodide in the filtered liquor is determined by

application of the colorimetric method. Gravimetric methods of determining the iodide as silver iodide, etc., are not satisfactory when dealing with material of such a complex nature as copper liquor. After a period of about a month has elapsed the precipitated silver iodide is removed from the tanks, washed free from copper salts with warm water, and treated for the recovery of iodide. The silver precipitate is then dried, sampled and assayed.

The amount of silver recovered is compared with the calculated weight obtained from assays conducted on the individual samples of copper liquor. If the figures do not compare favourably reasons must then be sought to account for the loss. A similar system is adopted to account for the passage of silver from the roasted ore to the silver department.

Tests for Protective Coatings

An Interesting French Method

THE exact protective value which, under varying conditions of utilisation, any one of the numerous materials in common use, such as nickel, copper, chromium, etc., possesses as an external coating to shield a metal against corrosion is not always easy to determine experimentally. A correspondent in *The Times Trade Supplement* gives an account of a new and very simple method of estimating the merits of protective coatings which J. Cournot, head of the Metallurgical Research Department of the Conservatoire des Arts et Métiers, Paris, recently communicated to a meeting of the French Association for the Testing of Materials. According to Cournot, the best way to decide on the efficiency of a protective coating consists in finding out whether its surface is perfectly continuous or not, since it is evident that a porous coating cannot protect a metal with any degree of thoroughness. To determine whether a protective coating is porous or not, and, if it be porous, to determine the extent of its porosity, Cournot proposes the use of a piece of ordinary filter-paper, previously soaked with an alkaline solution of a ferrocyanide. When applied to the protective coating, such a piece of moistened filter-paper shows, wherever there is a lack of continuity in the coating, indelible coloured spots brought about by the reaction which has taken place between the alkaline ferrocyanide solution and the metal below the coating. The fewer the spots, the more efficient the protecting layer.

With regard to the protection of ferrous metals by nickelling with previous coppering, the method makes it possible to determine simultaneously the porosity of the external layer of nickel and that of the intermediate layer of copper. If the nickel is porous the chemical reaction between the copper and the alkaline ferro-cyanide solution produces brown spots on the filter-paper; and if, in its turn, the copper is porous, blue spots are seen on the paper. The same method may also be applied to test the protection afforded (to iron) by zinc over a layer of cadmium. The yellowish-white spots caused in this instance by the reaction between the cadmium and the ferrocyanide, if the zinc layer is porous, cannot, however, be always easily distinguished from the white coloration produced by the reaction between the external zinc layer and the ferrocyanide solution. On the other hand, the blue spots produced by the iron, in case of the porosity of the cadmium, can always be clearly and unmistakably seen.

Chromite in Northern Ontario

AN interesting find of chromite is reported to have taken place at Obonga Lake, which lies directly west of Lake Nipigon in the Thunder Bay district of northern Ontario. According to Mr. Thomas W. Gibson, Deputy Minister of Mines of Ontario, samples that have been assayed at Queen's Park would indicate that the deposit is sufficiently high-grade to permit of its use in the connections in which the metal is employed, although no work has been done to determine the extent of the deposit or its economic importance. Chromite is largely used in alloys, particularly in the production of special steels, various stainless metals and electrical heating elements. It is also used in the manufacture of furnace refractories and chemicals for paints. New uses include radiator platings and the manufacture of quartz lamps.

Lanoline Rust Preventers

An Important Investigation

THE Department of Scientific and Industrial Research has just issued, as Engineering Research Special Report No. 12, a pamphlet on "Lanoline Rust Preventers," by C. Jakeman, of the National Physical Laboratory (H.M. Stationery Office, pp. 22, 1s.). The investigations described in the report were carried out at the National Physical Laboratory, Teddington, under the supervision of the Engineering Co-ordinating Research Board of the Department of Scientific and Industrial Research, following an inquiry by a Government Department as to the best material for the preservation of the bright steel parts of stored machinery. A preliminary examination of a number of representative rust-preventing mixtures showed that lanoline was superior to the other materials tested.

Lanoline v. Petroleum Grease

Lanoline is prepared from wool grease, a waste product of the wool-washing industry. Of late years processes of refinement have been introduced which yield, at a greatly reduced cost, a lanoline which satisfies the B.P. specification as regards acidity and moisture content, but is neither colourless nor free from odour. This material, called crude lanoline, was used in the preliminary tests and in most of the tests included in the present investigation. By a process of wool washing now being introduced, large quantities of lanoline of a little greater acidity can be produced and sold at £15 per ton. The quantities of lanoline which can be made available appear to be so great that there is no evidence that a rise in price would follow any probable demand for lanoline rust preventers. The material is, therefore, less costly than petroleum grease suitable for rust prevention, and its use would give an outlet for large quantities of home produced waste material in place of imported petroleum grease. The tests appear to show that such grease is superior to petroleum grease, even when the latter is specially rectified without regard to cost.

As regards solvents, the results of a number of experiments indicate that white spirit and solvent naphtha are inexpensive and satisfactory solvents for lanoline preservatives. If, for convenience of observation, coloured solutions are required, Aniline Scarlet BB or Aniline Blue may be added to the solution, the cost of which is thereby somewhat increased.

Application of the Lanoline Mixture

The following is a summary of recommendations regarding the use of lanoline: Lanoline may be used as a grease applied by means of a rag and should be well rubbed on the surface of the metal. If the lanoline is mixed with about 10 to 15 per cent. of white spirit it adheres to the metal more readily, and a thinner coat may be obtained. For application by brush or for dipping, solutions of lanoline in white spirit or in solvent naphtha (free from benzene) may be used. It is generally sufficient to clean the metal with a dry cloth before application of the mixture, and this treatment is advisable before the pieces are dipped. Satisfactory mixtures for use at temperatures from 40° to 80° Fahr. are made by taking equal parts by weight of lanoline and white spirit or solvent naphtha. Solution is rapidly completed if the mixture is raised to 60° C. (140° Fahr.). 7.8 lb. of lanoline in one gallon of white spirit yields about 1.9 gallons of preservative. 8.3 lb. of lanoline in one gallon of solvent naphtha yields about 1.9 gallons of preservative. One gallon of this mixture will protect approximately 1,200 sq. ft. of surface. White spirit dries less rapidly than naphtha, but is less inflammable. Both solutions are equally effective, and the inflammable vapour given off after the coating has dried for a few hours is negligible.

The grease or solution may be coloured by the addition of aniline dyes soluble in oil. The most satisfactory colours are obtained by adding Aniline Scarlet B.B. soluble in oil, or Aniline Blue soluble in oil to the lanoline. One-half of 1 per cent. of the weight of lanoline is sufficient in the case of Scarlet B.B., and from half to three-quarters per cent. of the weight of lanoline may be used in the case of the Blue. The approximate cost of the materials to make up small quantities of the above preservatives is 2s. 8d. per gallon uncoloured, and 3s. 4d. per gallon coloured. These prices are much reduced when large quantities are prepared.

In an appendix to the report specifications for the recommended materials are given.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Photomicrography of Iron and Steel

ALTHOUGH microstructural research may be said to have been initiated by the work of Sorby on rock and mineral sections some sixty years ago, it was soon applied to iron and steel, and the bulk of our knowledge of the constitution and constituents of metals has been derived from the study of ferrous materials. That the principles involved, and many of the theories arising out of them, have since been most successfully applied to other metals and alloys, does not affect the main issue that the photomicrography of iron and steel has been the basis of much of our knowledge relative to solid solution; to freezing phenomena in metals; to the segregation of impurities; and to the formation of definite and easily recognisable metal structures from which the life history of a metal and of its behaviour under varying conditions can be deduced. The study of the microstructure of iron and steel affords a clue to that of all other metals and alloys, and still occupies a position of prime importance as a mode of research. X-ray analysis may afford still further information, but can hardly supersede the use of the microscope.

How to Distinguish Structures

As, however, we cannot all be actual workers with the microscope, and as a photomicrograph conveys little meaning to the uninitiated, it is as well to have at least some guidance which will assist us to understand the meaning of the structures shown to us, and to distinguish not only one structure from another, but the causes to which they are due. This assistance can best be given by some kind of atlas, accompanied with simple explanations and specimen "typical" structures. One or two excellent atlases are already available, one, for example, published in Germany, but none the less there is ample room for the latest, which will be welcome not only to the expert, but to many earnest students, who, not having had special training in photomicroscopy, are often at a loss to know what a particular photomicrograph is supposed to convey. This purpose is admirably achieved in *Photomicrographs of Iron and Steel*, by E. L. Reed and Dr. Albert Sauveur (Chapman and Hall, 20s. net). It contains just what is needed; a graduated series of well-chosen and well-reproduced photographs of typical structures, with just the necessary explanation required as to the conditions under which they were obtained, and what they actually represent, to make them really useful and informative. The text is as clear as the illustrations, and the book is a welcome addition to the metallurgist's bookshelf.

Heterogeneity of Steel Ingots

THE Third Report of the Committee of the Iron and Steel Institute appointed some years ago to investigate the subject of the heterogeneity of steel ingots is a serious and painstaking contribution to the problem of producing sound ingots. The first two reports were good, but the present one is better. It consists of a lucid introduction, and four monographs, on the liquidus and solidus ranges of some commercial steels; the solubility of iron and manganese sulphides in steel; the density of molten steel; and the effect of latent heat on the solidification of steel ingots. For the two first Drs. Andrew and Binnie are responsible; for the third, Dr. Desch and Mr. B. S. Smith, and for the last, Mr. N. M. H. Lightfoot. All five workers have done their work in a masterly way. Emphasis should be laid on the fact that the present report is based on fundamental principles scientifically investigated. Not only were a range of ordinary commercial steels and certain chromium and nickel steels employed in the research, but a close study of their freezing phenomena has been made in comparison with that of commercially pure iron, from which a standard theoretical curve has been plotted whereby to compare and coordinate the results. *Pari passu* with this, an interesting series of micro-structures accompanies the work, showing the effect of the diffusion of carbon on the structure, in the case of a 0.46 carbon steel heated so that one end of a bar remained well below the melting point while the other end was completely melted. By sectioning the bar at intervals along its length the changes in structure and the effect of the carbon diffusion are well brought out. Broadly speaking, it was established under the conditions of the experiment that diffusion of the carbon was not sufficiently

rapid to bring about homogeneity. It would seem that diffusion does not occur on a falling temperature.

Carbon Diffusion

As the time factor in this case was large (one hour was allowed for heating), the deduction may be made—although the investigators do not actually make it—that even in ordinary practice carbon diffusion plays a comparatively small part in bringing about homogeneity, in respect of that element in steel ingots. Indeed, as the report says, even in large carbon steel ingots it probably takes place to far less an extent than is commonly assumed. For the rest, and provided the manganese is below 0.45 per cent., the liquidus and solidus curves of commercial steels conform in respect of carbon content and temperature with the iron-carbon diagram, while nickel-chromium and nickel steels freeze at lower temperatures, although their melting points occur at practically the same temperature as plain carbon steels of corresponding carbon content. The research on iron and manganese sulphides shows that, as regards the former, sulphur may be retained in solution in appreciable amounts by rapidly cooling the melt, and some remains even in slowly cooled metal. The investigations on manganese-iron-sulphur alloys gave results insufficiently definite to warrant hard and fast conclusions, but seem to show that manganese sulphide, if at all soluble in solid iron, is only slightly so. This seems to support the generally-accepted views and to justify existing practice in regard to the function of manganese additions to the bath in steel making, as far as sulphur is concerned.

Use of Pure Iron in Experimental Work

THAT there is a growing recognition of the importance of correlating the results of experiments on the influence of impurities by control experiments on commercially pure metals is rather strikingly brought out in several of the papers read this week at the annual meeting of the Iron and Steel Institute. Thus, in the heterogeneity of ingots report, the theoretical curve was referred to the behaviour of "Armco" iron, and this material was also used in the section on sulphides in steel, the experimental melts being made with this commercially pure iron. It was used—and behaved uncommonly well—in the interesting paper on the erosion of guns by Dr. Greaves and two of his colleagues of the Research Department, Woolwich Arsenal, and in Mr. Bolsover's paper on "Brittleness in Mild Steel." It was also used in another paper. Its only rival, electrolytic iron, was used in the experimental work described by Dr. Pfeil, in his paper on "The Oxidation of Iron and Steel at High Temperatures." In this paper Dr. Pfeil comes to the interesting conclusion that iron, during high temperature oxidation, diffuses outward, through its own oxidation sheath, while oxygen diffuses inwards, towards the surface of the metal. He found that the outer part of the scale is the last to form, the middle portion being the first. Reverting for a moment to the pure iron question again, one of the papers shows that remelted "Armco" readily decarburises. As the original carbon content is exceedingly small, a further source of very high grade "commercially pure iron" would thus seem to be readily available for large-scale experimental work.

Darwins, Ltd.

DARWINS, LTD., has been registered as a public company, to acquire all or any part of the undertaking and assets and liabilities of the undertaking of the same name, and to carry on the business of steel and iron merchants, steelmakers and converters, etc. The nominal capital is £730,000, in 400,000 "A" preference, 300,000 "B" preference, and 30,000 ordinary shares of £1 each. Darwins are reported to have received an order valued at £100,000 for special cobalt magnet steel, from Phillips Radial, of Kindhaven, Holland. Recently the firm's sales have grown remarkably. Darwins specialise in safety razor blades, and, despite American tariffs, their sales in the United States have recently reached record proportions. Razor blade manufacture now represents the smaller proportion of their output. They have developed a wide connection in high-class steel. They are now employing 1,200 hands, and are enlarging their staff almost weekly. They have more than six months' work in hand.

Heat-Resisting Steels

At a recent meeting of the Society of Glass Technology, Mr. R. J. Sargent read a paper on "Heat-Resisting Steels with Special Reference to their Application in the Glass Industry." The paper described the properties of heat-resisting steels and gave a brief review of recent developments in their industrial application. The materials described were the outcome of extensive researches on the part of Sir Robert Hadfield and the research staff of his company in Sheffield, and their French associates of the Imphy Steel Works, a distinguished group including Chevenurd, Dumas, Guillaume, Fayol, Girin and Mugnet. Heat-resisting steels, said Mr. Sargent, were materials which combined resistance to heat, both as regards scaling and strength, with tenacity, ductility, malleability and machinability. Strength and malleability at high temperatures had been combined in an achievement of far-reaching utility. Progress in the development of practical forms had resulted in the production of machined castings and forgings, sheet, rolled sections, wire and even hot-rolled tubes.

The alloys described had in general a homogeneous structure, an absence of thermal critical change points, and remained permanent in their physical character in service. They found their best usefulness in the range of temperature 600-1100° C. There were alloys of a somewhat more brittle nature which were capable of resisting oxidation up to 1200° C. The composition of the alloys described covered two separate ranges: 10-25 per cent. chromium with 7-10 per cent. of nickel and 65-75 per cent. iron; and 10-15 per cent. chromium with 30 to 40 per cent. nickel and 50-60 per cent. iron. In all cases, silicon, tungsten, molybdenum, etc., might be added according to requirements.

Applications in the Glass Industry

THE special applications of these steels to the glass industry included recuperator tubes, glass moulds, blowing irons, feeder nozzles and conveyor chains for annealing lehrs. Recuperators made of heat-resisting steel had been used extensively. They were robust, did not leak, occupied small space, and permitted the use of high gas velocities and a high rate of heat transmission. Coefficients as high as 258 B.Th.U. per hour per square foot per 1° F. had been obtained, and air had been preheated to 950° C. Up to 1000° C. working temperature the tubes had a life measured in years, and a considerable life was obtained at temperatures as high as 1100° C. The possibilities of the metallic regenerator were indicated, the thermal advantage of the metal chequer being 18 times that of, say, firebrick, but the main utility of heat-resisting alloys would be for the moving regenerator. A case was described of the application of special steel to glass moulds, which enabled the output of bottles to be raised from 50,000 to 2,000,000 without replacement.

An intermediate type of material, being a silchrome steel, containing 8.9 per cent. of chromium and 3 to 3½ per cent. of silicon, had a range of uses where conditions were not so severe as to demand the higher grade of materials.

Production was now dealt with in comparatively large tonnages, up to 3 tons in the case of single castings. The higher initial cost, it was pointed out, must be judged in the light of superior performance and consequent saving from length of service, and particular regard was to be paid to the unforeseen field of development in which the best progress always lay.

Aluminium Brass Condenser Tubes

NOTES have already appeared in these columns with regard to the corrosion-resistant aluminium brass (Cu 76 per cent., Zn 22 per cent., Al 2 per cent.) which was developed some time ago by the British Non-Ferrous Metals Research Association, and the special application of the brass to the manufacture of condenser tubes was mentioned. The brass is known as Al-dur-bra, and we are informed by Charles Clifford and Sons, Ltd., of Fazeley Street Mills, Birmingham, that they are now manufacturing Al-dur-bra tubes at prices little above those prevailing for ordinary 70/30 brass tubes. It is found to be of supreme importance in the manufacture of these tubes that the tube castings should be produced by the Durville process, a French process for rotatory pouring.

Corrosion Resistant Properties

At the meeting of the Institute of Metals at Liverpool last September reference was made to some experiments in which

tubes of Al-dur-bra and 70/30 brass respectively were exposed to the action of aerated sea-water for nine months. As a result, the 70/30 brass tubes were considerably corroded, and, at the inlet end, thinned by erosion. The Al-dur-bra tubes, on the other hand, showed no appreciable attack, and had a yellow surface with somewhat the appearance of an enamelled or lacquered finish as in the original metal. Further work has shown that this distinguishing feature is due to the formation of a film or coating of a highly protective nature; of still greater importance, however, and probably of quite an exceptional character, is the automatic re-formation of this protective film should it become broken or worn. Experiments have clearly shown that the film, if deliberately abraded, quickly heals up when the metal is left freely exposed to aerated sea-water.

Al-dur-bra tubes have so far proved particularly of interest for marine condensers, land condensers for electricity generating works, and for triple-effect tubes for sugar refineries. No doubt they will be found useful for many other purposes. In connection with the projected use of Al-dur-bra tubes for triple-effect tubes for sugar refineries, where ammonia attack may be met with, tests have shown that Al-dur-bra is much more resistant than 70/30 brass to the corrosive action of 0.880 ammonia, dilute ammonia solution, and moist ammonia gas.

Corrosion of Oil Storage Tanks

A FIELD laboratory designed for conducting tests on steel and aluminium tanks used in the storage of crude petroleum containing corrosive sulphur compounds is being established near Borger, Texas, by the United States Department of Commerce, in co-operation with the Gulf Oil Co., the Parkersburg Rig and Reel Co., and the Aluminum Co. of America. The Department of Commerce will be actively represented in the investigation by members of the technical staff of the Petroleum Experiment Station of the United States Bureau of Mines. The tests will extend over a period of twelve months. The rapid corrosion of tankage, pipes and equipment by oil of this nature constitutes one of the serious problems of the oil industry.

The problem of preventing the corrosion of oil tanks and other storage equipment is not new in the petroleum industry, but with increased production of high-sulphur crudes in the Texas Panhandle and West Texas areas the problem has assumed extremely serious proportions. It has been estimated that in certain fields of Texas one tank out of every five has to be replaced every year because of the high sulphur content of the crude. One method suggested for combating tank corrosion is the use of materials which have a high resistance to the corrosive action of hydrogen sulphide and high-sulphur crudes. Aluminium is one of these materials.

The Plan of Investigation

At a recent conference between representatives of the Bureau of Mines and the co-operating companies a plan of investigation was outlined to determine the relative resistance and adaptability of tanks made of steel and aluminium. The rate of tankage corrosion is more pronounced in the Texas Panhandle than in the west Texas fields, although the percentage of hydrogen sulphide in the gas produced with the crude is appreciably less. Comparative data show that the hydrogen sulphide content of the gas coming from the "Big Lime" formation in the Texas Panhandle averages 0.50 to 0.65 per cent. by volume, whereas the hydrogen sulphide content of the gas in the Big Lake, McCamey, and Crane Upton fields is 10, 6, and 8 to 12 per cent. by volume, respectively.

Five new tanks will be used in the test battery; one 500 barrel aluminium treating tank, two 250-barrel aluminium storage tanks, and two 250-barrel steel tanks. It is proposed to subject the four 250-barrel tanks to the same storage conditions. The treating tank will be subjected to more vigorous conditions than the storage tanks. The oil will be heated and treating compounds used, and the fluid agitated in this tank in accordance with present lease practice. All test tanks will be under close observation for indications of corrosive action. Several recording devices will be used in connection with the work. The results of these tests will be published later by the Bureau of Mines.

Trade, Commerce, Finance : The Month in Review

From Our Market Correspondent

THE interest, almost amounting to excitement, with which the joint meeting of the Steel Associations was awaited by all sections of the iron and steel industry has subsided. The announcement was made, after the meeting held on April 17, that there was to be no change in the official prices for steel plates and sections. Apparently this decision was not reached without a great amount of argument, but evidently there was not sufficient unanimity to warrant a change being made.

It is difficult to understand why this course was taken. In the first place, it was generally expected that prices would advance. Buyers in all parts of the country were prepared for higher prices, as was proved by the large amount of forward buying, on both fixed and provisional contracts, which had taken place during the previous weeks. This experience was common to all the steel makers, and must have shown them that consumers were anticipating an increase in price.

The Price of Steel

Such an expectation was based on sound reasoning. The selling prices of steel have been at an unremunerative level for a long time, and as has previously been pointed out, there has recently been a definite increase in the cost of production, so that the natural thing for the steel makers to do was to put their selling prices at a level at least sufficient to cover the extra cost. A moderate advance would have had no adverse effect on the volume of trade.

It is admitted that the steel works are not employed to their full capacity, and that is the basis of the argument of those steel makers who are opposed to an advance in selling prices at present. Their contention is that no advance is possible until the works have sufficient orders to operate full time, and when that condition is reached, then will be the time to advance prices.

Output

Such an argument seems to ignore one important fact, which is that there is not the least probability, in normal trading conditions, of the whole of the steel works attaining to full output, and to wait for that state to be realised is like wishing for the moon. Reduce the whole productive capacity by about one-third, and there may then be reasonable hopes of its realisation, but not otherwise. The fact must be recognised that as long as all the existing steel works continue to operate and to compete with each other for the available business, so long will there be part time operation. The control which is exercised by the Steel Associations is clear proof of that. Every maker knows that were it not for this control there would be an outbreak of price cutting which would soon bring disaster in its train, and for that reason the Associations are keenly alive to the necessity of ensuring that the official prices shall be strictly observed by every member. It has been proved possible to ensure this adherence in spite of the lack of orders, and, therefore, there is no good reason why the prices should not have been advanced at the last meeting in order to enable the steel makers to avoid making additional losses. However, the announcement of no change has gone forth and the steel makers will continue to supply plates and sections at the old prices, and be as cheerful as they can when they are called upon to pay still further increases for fuel and raw materials.

United Steel Companies

Considerable interest has been aroused by the offer of the Austin Friars Trust to purchase the share holdings in the United Steel Companies. It is not surprising that the directors of this group of steel works and collieries are in favour of acceptance of the offer. It is possible that if and when the deal is concluded, the undertaking and any others which are brought in will be floated as a new company. Something of the kind will be done, as the whole thing is essentially a financial operation.

In the Press, much emphasis has been laid on the fact that one of the main objects of the scheme is to rationalise the

steel industry and help it to regain its former prosperity. That is a very laudable object which one would like to see achieved, and consequently the development of the scheme will be followed with close interest. At the moment, however, the thing that impresses outsiders is that the Trust is acquiring one of the largest sections of the steel trade at very favourable prices. It is stated that when the negotiations with the United Steel Companies are completed, other sections of the industry are to be taken over, and rumour couples the names of two of the largest steel works in the North of England with this extension.

The Question of Distribution

In the comments which have appeared on the subject, one point was mentioned which is worthy of notice. There is a great deal of waste at present in the manner in which the steel requirements of the various parts of the kingdom are being supplied. The North-East Coast makers, for instance, send steel into Scotland and the Midlands, while the Scottish makers in turn send steel down to the North-East Coast and the Midlands districts. All this means a distinct loss to the steel makers, as there is a heavy railway carriage from one district to the other, although the delivered price remains the same. If some arrangement could be made whereby the steel could be supplied from the works nearest to the point of consumption there would be a large saving in carriage, all for the benefit of the steel makers.

Admittedly, there are difficulties in the way of such an arrangement, but they can be overcome. In the scheme put forward by the Austin Friars Trust this trouble would largely disappear. By centralising the control of these sections of the industry, it would be possible to allocate the orders to the mills under its control which could supply the steel with the least expense in production and railway carriage.

Market Conditions

The general tone of the iron and steel markets during the past month has been one of confidence. There is some increase of business reported from all quarters, and in each section of the trade prices are firm. The output figures show a marked increase in production, much of which can be accounted for by the reduction in the quantity of foreign steel, particularly semi-finished steel, which is being offered here, and the ever narrowing margin between the foreign and home prices. As a result of this, there is a good demand from the re-rollers for English billets. Formerly the re-rollers using continental billets could undersell the British steel makers of steel bars by nearly 20s. per ton, but the difference is now reduced to a few shillings, and this is not sufficient to give the preference to foreign steel.

The steel trade is helped considerably by the continued activity in the motor trade. The resultant demand for pressing steels, bright drawing bars, etc., is better than it has been for some years. Most of the bar mills are working full time on this class of work. In the larger sizes and in sections there is not nearly so much business passing, and immediate delivery can easily be obtained for any good specification. The plate mills, too, show no improvement in the volume of work obtainable.

Pig Iron

The pig iron market retains its firmness, although there has not been much buying during the past month. The association formed by the midland blast furnaces has stabilised prices, but most consumers booked ahead before the association was formed and are now awaiting developments. The Cleveland market is very firm, as the demand has overtaken the supply. There is likely to be an increase in production in the near future.

The output of pig iron during March amounted to 590,500 tons, as compared with 519,600 tons in February. The number of furnaces in blast at the end of the month was five more than at the beginning. The output of steel was 859,900 tons, as compared with 774,900 tons in February.

Some Inventions of the Month

By Our Patents Correspondent

Abstracts of other Patents of metallurgical interest will be found in our Patent Literature, published weekly in THE CHEMICAL AGE.

Alloys

ALLOYS having valuable properties of high differential electro-magnetic permeability and high electrical resistance, and therefore specially suitable for loading telephone conductors or for the cores of transformers, are described in Specification 308,643 (Patent of Addition to 284,789), dated December 23, 1927, by W. S. Smith, of Newton Poppleford, Devonshire, H. J. Garnett, of Sevenoaks, Kent, and J. A. Holden, of Gidea Park, Essex. The alloys, which are substantially free from carbon, contain 40–50 per cent. of iron, 1–5 per cent. of silicon or aluminium, 1–5 per cent. of chromium, molybdenum, tungsten, or vanadium, and the balance nickel amounting to not less than 42 per cent., and preferably 45–55 per cent. An addition of 0.2–0.3 per cent. of manganese is desirable. Copper (up to 5 per cent.) may replace some of the nickel. The valuable properties of the alloys are enhanced by a heat treatment comprising heating the ingots, shaped to the desired form, to 900–1,100° C., preferably in an inert atmosphere, maintaining them at that temperature for about 15 mins., and cooling to room temperature in about 20 hours.

THE production of vanadium alloys is described in Patent Applications 305,201–2, bearing the International Convention date February 2, 1928, by Vanadium Corporation of America, Bridgeville, Pennsylvania, U.S.A. According to Application 305,201, ferro-vanadium alloys containing 85–95 per cent. of vanadium are made in an electric furnace by the use of silicon as reducing agent or by thermo-reduction of high-grade vanadium pentoxide by means of aluminium, the product containing less than 1.25 per cent. of silicon and less than 0.5 per cent. of carbon. According to Application 305,202, alloys containing 40–90 per cent. of vanadium, 3–15 per cent. of aluminium, and 5–30 per cent. of silicon, with or without some iron, the carbon content being less than 0.5 per cent., are made by thermo-aluminic reduction of vanadium pentoxide. They are useful for introduction into a molten steel bath, the aluminium and silicon serving as deoxidising agents.

ALUMINIUM-SILICON alloys in the "modified" state—i.e., having a finer microstructure, and of better strength and ductility than the "normal" alloys—are obtained by the addition of a carbonate or bicarbonate of an alkali metal to the molten alloys. Thus, 4 per cent. of powdered anhydrous sodium carbonate may be added to a melt, heated to 1,000° C., of an alloy containing 5 to 15 per cent. of silicon. See Specification 305,311, dated November 24, 1927, by A. Phillips and E. Baron, of Manchester, and Metropolitan-Vickers Electrical Co., Ltd., of London.

Aluminium

PURE aluminium is produced electrolytically by the use of solid anodes of the material to be refined, solid cathodes, and an electrolyte, which has a melting point lower than that of the electrodes and is composed of halogen salts of aluminium and alkali or alkaline earth metals as described in Specification 265,170 (see THE CHEMICAL AGE, Vol. XVI, p. 47 [Metallurgical Section]). The anodes are ribbed or grooved to increase their surface area. See Patent Application 305,458, bearing the International Convention date February 4, 1928, by Aluminium Industrie Akt.-Ges., of Neuhausen, Switzerland.

Iron

IN a cyclic process for obtaining ferric oxide from iron ores, particularly sulphide ores, the ores are chlorinated at about 375° C. to produce ferrous chloride, which, after removal of diluent gases from the system, is further chlorinated to produce ferric chloride, and this is burned with air at 700–800° C. to produce ferric oxide and chlorine. Part of this chlorine is used to chlorinate a further quantity of the ore, and the remainder to convert ferrous chloride to ferric chloride. The sulphur is recovered. See Patent Application 306,107, bearing the International Convention date February 16, 1928, by Comstock and Wescott, Inc., of Boston, U.S.A.

Pickling Metals

ACCORDING to Patent Application 305,036, bearing the International Convention date January 28, 1928, by Q. Marino, of Paris, surfaces of iron or steel are cleaned by anodic

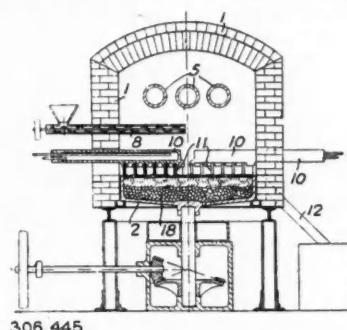
treatment at 70–80° C. in an electrolyte obtained by adding sodium or potassium sulphate to a solution produced by treating pulverised phosphate of lime or other phosphate with sulphuric acid of 10–20° Bé.

Separating Ores

A METHOD of and apparatus for separating ores from each other or from gangue by the utilisation of differences of electrical conductivity are described in Patent Application 305,102, bearing the International Convention date January 30, 1928, by British Thomson-Houston Co., Ltd., of London, Assignees of J. A. Seede, of Schenectady, New York. The materials are caused to pass, preferably by gravity, through an alternating magnetic field, and the resulting eddy currents in the differently conducting particles cause these particles to be deflected to different degrees and thus separated.

Tin

TIN ores are smelted in a furnace comprising a chamber (1), in which is maintained a reducing atmosphere containing at least 60 per cent. by volume of carbon monoxide, and a dished rotary hearth (2) provided with material such as spongy iron for filtering the molten tin. Heat sufficient to maintain the temperature at about 950° C. is supplied electrically or by



the combustion of liquid or powdered fuel in refractory tubes (5). Powdered ore, together with fuel for maintaining the reducing atmosphere, is delivered by a feeder (8) to the centre of the hearth, and the charge is moved outwards by rabble arms (10) carrying teeth (11) of hard carbon, the solid residue from the molten tin being discharged through a peripheral shoot (12). See Patent Application 306,445, bearing the International Convention date February 20, 1928, by Cayzer Tin Smelting Co. (Proprietary), Ltd., of Johannesburg, South Africa.

A DRY process for extracting tin from crude tin-bearing material is described in Patent Application 306,108, bearing the International Convention date February 16, 1928, by D., M., S. R., and S. Guggenheim, J. K. MacGowan, and E. A. C. Smith (trading as Guggenheim Bros.), of New York. The material, preferably briquetted with molasses or sulphite liquor, is subjected to a preliminary treatment to remove impurities, and is thereafter reduced by means of a carbonaceous reducing agent and a mixture of alkali and alkaline earth fluxes, preferably soda and lime with the latter in excess. A suitable preliminary treatment comprises heating with sulphuric, phosphoric, nitric, hydrochloric, or other acid, followed by successive leachings with sodium chloride and sodium hydroxide solutions. Silver, bismuth, and lead are recovered from the sodium chloride leach liquors, and tungsten from the sodium hydroxide leach liquors.

Zinc

A PROCESS designed to effect economies in the desulphurising of zinc ores by sintering is described in Specification 307,595, dated February 7, 1928, by H. J. Stehli, of Cedar Grove, New Jersey, U.S.A. The ore is roasted to a point at which the residual sulphur, as sulphide, is insufficient to carry on sintering, whereupon the roasted ore is mixed with sufficient zinc residues from the distillation retorts to supply the carbon required to furnish heat and to reduce sulphates, and is blast roasted to eliminate the sulphates and to sinter the mass. The sintered product is such that when mixed with carbon and treated in a retort the heat of combustion of the carbon causes reduction and volatilisation both of the zinc contained in the ore and of that contained in the zinc residues.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—The transformation of the β -phase in zinc-copper alloys. Grounds for the disagreement in the experimental results obtained by different investigators. P. Saldau. *Zeitschrift für Metallkunde*, March, pp. 97-98 (in German).

APPARATUS.—An electric heating oven for metals. M. Tama. *Zeitschrift für Metallkunde*, March, pp. 77-78 (in German).

CORROSION.—The mechanism of oxidation processes. XVI.—The rusting of iron. H. Wieland and W. Franke. *Annalen*, Vol. 469, Part 3, pp. 257-308 (in German). The question of the formation of hydrogen peroxide in the rusting of iron; the course of the auto-oxidation of iron in amalgam; iron amalgam and hydrogen peroxide; the auto-oxidation of iron powder; the influence of passivating substances on the auto-oxidation of iron; the substitution of oxygen by other hydrogen acceptors.

Experiments on the corrosion of aluminium and of aluminium alloys susceptible to heat treatment. W. Schwinning and H. Jahn. *Korrosion und Metallschutz*, March, pp. 49-58 (in German).

Corrosion in centrifugal pumps. R. W. Müller. *Korrosion und Metallschutz*, March, pp. 59-61 (in German).

The ferroxyl indicator. W. van Wüllen Scholten. *Korrosion und Metallschutz*, March, pp. 62-64 (in German). Deals with the use of the ferroxyl indicator for corrosion tests.

GENERAL.—The utilisation and working up of metallic residues. R. Graubner. *Chemiker-Zeitung*, April 17, pp. 307-308 (in German).

Tungsten as a material in technical chemistry. H. Alterthum. *Zeitschrift angewandte Chem.*, March 16, pp. 275-278; March 23, pp. 308-314. Production of the metal; applications of the pure metal (coatings, surface hardening, electrodes, and catalysis); application of tungsten alloys (with copper, lead, nickel); acid-resistant alloys; tungsten steel; tungsten carbide alloys (Stellite, sintering substances); applications of tungstic acid and tungstates.

The penetration of hydrogen into metal cathodes and its effect upon the tensile properties of metals and their resistance to repeated stresses; with a note on the effect of non-electrolytic baths and nickel plating on these properties. F. C. Lea. *Proc. Roy. Soc. A.*, March 6, pp. 171-185. Nascent hydrogen liberated at a cathode penetrates the crystal boundaries of mild steel, nickel, and "rustless" steel (containing nickel and chromium). The tensile strength is unaffected; the elongation of the mild steel is lowered.

Invisible oxide films on metals. F. H. Constable. *Nature*, April 13, p. 569.

Injurious and useful actions of gases in steel. F. Rapatz. *Zeitschrift für Metallkunde*, March, pp. 89-97 (in German).

The stability of metals at elevated temperatures. C. L. Clark and A. E. White. *Trans. Amer. Soc. Steel Treating*, April, pp. 670-714. A research into three points; the relation between the results obtained from short-time tensile and long-time creep tests; the factors affecting the stability of metals at elevated temperatures; and the mathematical relationship between the variables encountered in long-time testing.

PASSIVITY.—The theory of passivity phenomena. IV.—The dependence of the specific time of passivation of iron on the concentration and nature of the electrolyte. W. J. Müller and O. Löwe. *Monatshefte*, Vol. 51, Parts 2-3, pp. 73-85 (in German).

SINGLE CRYSTALS.—Single crystals of silver. E. W. R. Steacie and F. J. Toole. *J. Amer. Chem. Soc.*, April, pp. 1134-1135. Single crystals of silver can be prepared by slow cooling of the molten metal. Dilute nitric acid attacks the faces in a specific manner, yielding prismatic crystals.

The distribution of lead present as impurity in single crystals of zinc. M. Straumanis. *Zeitschrift anorganische Chem.*, Vol. 180, Part 1, pp. 1-10 (in German).

The behaviour of a single crystal of zinc subjected to alternating torsional stresses. H. J. Gough and H. L. Cox.

Proc. Roy. Soc. A., March 6, pp. 143-166. Deformation, by slip, of a single zinc crystal is controlled purely by resolved shear stress considerations, and occurs along the most highly stressed primitive direction contained by the basal plane.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

EAGLE LEAD CO., LTD., London, E.C. Registered March 26, £10,000 debenture, to S. Japhet and Co., Ltd., bankers; general charge. *Nil. December 31, 1927.

GUNONG TINGGI TIN MINES, LTD., Folkestone. Registered March 18, series of £5,000 debentures, present issue £2,850; general charge.

STANDARD STEEL CO. (1929), LTD., Croydon. Registered April 5, debenture to bank; general charge.

Satisfaction

BRADLEY AND FOSTER, LTD., Darlaston, iron manufacturers. Satisfaction registered April 10, £7,000, registered December 7, 1906.

The Copper Situation in Canada

THE discovery of important copper deposits in the Rouyn area of Western Quebec; at the Froid and Froid Extension copper-nickel mines and at the Errington zinc-copper mine in the Sudbury district, Ontario; the successful development work in progress at the Flin Flon and Sherritt-Gordon mines in The Pas district, northern Manitoba; the additions to plant equipment at Anyox, Britannia Beach, and Copper Mountain; and the successful results obtained at the Coast Copper property on Quatsino Sound in British Columbia, are all new factors likely to make a substantial increase to the Canadian production of copper. The completion of the Noranda smelter in the Rouyn area has raised Quebec to the rank of an important producer. One unit only of the smelter, originally designed for treating 500 tons of ore per day, has already reached a capacity of nearly 1,000 tons. The very successful development campaign of the International Nickel Co. at the Froid mine and that of the Mond Nickel Co. at its Froid Extension mine, have opened up enormous reserves of good grade copper-nickel ore. The International is also proceeding with the erection at Copper Cliff of a large concentrator and a new 4,000-ton copper smelter, which will be supplemented with a copper refinery, probably to be located at Port Colborne.

The Errington zinc-copper mine near Sudbury has been proceeding with its development campaign. At the Flin Flon property in northern Manitoba the ore reserves are estimated at 16,000,000 tons to a depth of 900 feet. The ore body averages 1.7 per cent. copper and 3.5 per cent. zinc, with low values in gold and silver. Results at the Sherritt-Gordon have been very encouraging, and the property is being actively developed. The ore zone has been traced for several miles and two ore bodies definitely proven. Of these the eastern is said to contain 2,000,000 tons and the western 3,000,000 tons to a depth of 500 feet. The average assay of the ore has been given as: copper, 2.3 per cent., zinc 5.9 per cent., with small amounts of gold and silver. Important new developments are reported from British Columbia at some of the producing properties and new discoveries are also reported. The prevailing low price of copper during the past few years has been offset to some extent by improved methods of concentration and metallurgical treatment.

Monthly Metallurgical Section

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NOTICE.—Communications relating to editorial matter for our *Monthly Metallurgical Section* should be addressed to the Editor, THE CHEMICAL AGE, Bouverie House, 154, Fleet Street, London, E.C.4. Communications relating to advertisements and other business should be addressed to the Manager. Contributions will be welcomed from correspondents on any points of interest to metallurgists bearing on works practice or current research problems.

The Production, Properties and Uses of Special Brasses

(FROM A CORRESPONDENT)

THE wide range of copper-zinc alloys which constitute the brasses are among the earliest known alloys of industrial importance, and are the most generally used of the heavy non-ferrous alloys to-day. A very great variety of brasses are used for innumerable commercial applications, and efforts are being constantly made to improve the quality of existing standard brasses and to produce stronger alloys, or alloys more suited to special purposes, by the addition of alloying elements to brass.

The brasses are usually divided into two main groups: those consisting of more than about 64 per cent. copper, which are homogeneous alloys composed of the alpha solid solution; and those containing from about 55 to 64 per cent. copper, which are duplex in constitution, being composed of the alpha and beta solid solutions as separate constituents. Brasses of 70:30 composition typify the first class and those of 60:40 composition the second. The effect of adding zinc to copper is to increase progressively the strength, toughness and hardness of the alloy up to 36 per cent. zinc, after which the increase in strength is more marked.

In the cast state the 70:30 alloy has a tensile strength of about 15 to 20 tons per square inch, and that of the 60:40 alloy is about 25 tons per square inch. It is possible, however, to raise the strength of the latter type of brass to more than 30 tons per square inch in the cast condition by the addition of certain alloying elements.

Alpha Brasses

Reverting to the first or alpha class of brasses, various compositions from as little as two or three per cent. of zinc up to the maximum of 36 per cent. are regularly made and used. The high copper alloys such as those containing from about 92 to 97 per cent. copper, often known as gilding metals, are used as medal metals and for making caps for cartridges. The colour of the alloy is often of great importance for certain purposes, and the composition of many of them is governed by this consideration. The alloy known as Tombac, for example, closely resembles the colour of gold and is used in making imitation jewellery. It usually contains 10 to 18 per cent. zinc. Pinchbeck, which is of a dark gold colour, contains about 7 to 11 per cent. zinc.

The straight 70:30 brass is known as cartridge brass, provided it conforms to recognised specifications regarding the amounts and nature of impurities which it contains, and in the annealed condition after cold working it possesses a tensile strength of 20 to 22 tons per square inch and an elongation of 60 to 70 per cent. In the hard state the strength of the alloy may reach as much as 40 tons with an elongation of 10 to 12 per cent.

Another well-known brass, often referred to as the two and one mixture, is that containing 65 to 66 per cent. copper. This is very widely used in the strip and sheet form for the manufacture of pressings and drawings. All the straight brasses in the alpha class are ductile and readily workable in the cold. Although they are not usually subjected to hot-working operations, most of these alloys can be hot-rolled provided due consideration is given to the temperature at which the rolling is carried out, and provided that harmful impurities are not present in amounts sufficient to render the material hot-short.

Addition of Various Elements

To many of the brasses in the alpha range alloying elements, especially tin, lead and aluminium, are added for various purposes. Those alloys, for example, known as steam metals or red brasses, used for valves, plumbing castings, etc., contain

usually 80 to 90 per cent. copper, together with varying amounts of zinc, tin and lead. Some of the brasses containing tin as a third element are well-known alloys, the most prominent of which is perhaps that modification of the 70:30 alloy containing 20 per cent. zinc and 1 per cent. tin, known as Admiralty brass, and which is used for making condenser tubes. Depending on the condition of the material, the tensile strength varies between 20 and 40 tons per square inch and the elongation from about 10 to 75 per cent. Pen metal is another ternary alloy of this type, and contains 85 per cent. copper, 13.5 per cent. zinc and 1.5 per cent. tin.

In brasses used for general casting purposes, aluminium is sometimes added with the object of making possible a larger zinc content, but this causes greater shrinkage and more dressing, allowance for both of which must therefore be made. The usual yellow casting brass contains about 27 per cent. zinc, 2 per cent. lead and 1 per cent. tin. Apart from casting alloys of the alpha class, lead is more usually added to duplex alloys, for reasons given later, but there are a few alloys of the former class, which are not primarily casting alloys, which contain lead. One of these is known as extruding bronze, and usually contains about 10 per cent. zinc, 2.5 per cent. lead and the remainder copper. Another brass, containing about 33 per cent. zinc, and 2 to 3 per cent. lead, is used for engraving.

Muntz Metal

The most widely used non-ferrous alloys for engineering purposes are, perhaps, the brasses containing from 55 to 64 per cent. copper. These alloys are used for both hot-working, such as rolling, extruding and stamping, and for casting purposes. The most typical of the straight alloys of this class is Muntz metal, which contains 60 to 62 per cent. copper and 40 to 38 per cent. zinc. In the cast condition, the strength of this alloy is about 25 tons per square inch, and the elongation about 50 per cent. It is this class of alloy which forms the basis of the so-called special brasses and those which have been named high-tensile brasses. The various uses to which this class of brass have been put has resulted in the development of special compositions to give properties particularly well suited for definite purposes. It is the demand for brasses with special properties which has led to the use of alloying elements in this type of brass, and while many of these additions have hitherto been made on purely empirical grounds, a considerable amount of systematic investigation has been carried out to ascertain more precisely the effects of different elements on the properties of these brasses. Even so, this field of investigation is still very incompletely explored, and there is scope for much further work before the possibilities of special and high-tensile brasses have been exhausted.

The Addition of Lead

One of the commonest elements found in association with alpha-beta brasses, apart from its occurrence as a normal impurity, is lead. This element is added to improve the machining qualities of the material, and its effect in this direction is very important, for this alloy is widely used for machining purposes. In the form of extruded rod a very considerable amount is used for the manufacture of small articles by machining; usually for economic reasons the machining must be done at high speeds, and the machining qualities of the brass must be such as to meet these requirements. The composition of leady brasses varies, but the copper content usually runs between 56 and 60 per cent. The improvement in the machining qualities of the alloy is abundantly manifest when the lead content is 1.5 to 2 per cent., but for the free-

turning quality alloy the lead reaches 2 to 3 per cent. The effect of the lead is to cause the turnings of the metal to come away in small pieces and clear the tool easily. In the preparation of these alloys it is essential to have the lead thoroughly mixed, for the full benefits attendant on its presence are not obtained unless it is evenly disseminated in a finely divided form throughout the alloy. There are a great many variations in composition of this type of alloy to meet specific requirements. For example, in the case of rod for hot-stamping it is not desirable to have the lead as high as it is in free-turning brass, for it tends to impair the hot stamping qualities; on the other hand, the beneficial effects, so far as machining qualities are concerned, are desired, so the lead content is fixed at about 1 or 1.5 per cent., in an attempt to meet one requirement partly without appreciably jeopardising the other.

The Addition of Manganese

Manganese is another element specially added to the 60:40 type of brass, but in this case the object is to increase the strength. Such alloys are generally known as manganese bronze, and in the cast conditions a tensile strength of 36 tons per square inch can be obtained. Frequently the manganese bronzes contain this element in little more than traces, but it is considered that it should be present to the extent of about 1 per cent. to exert its maximum beneficial influence. In most of the manganese bronzes of commerce, small amounts of other elements such as aluminium, iron and tin are found. The alloy has met with very successful application in the form of castings for ships' propellers. Guillet found that the addition of manganese up to 10 per cent. to 60:40 brass brought about a progressive increase in the tensile strength and a decrease in the elongation. Turbadium bronze is a manganese bronze containing about 48 per cent. copper, and, in addition to manganese, 2 per cent. aluminium, 2 per cent. nickel, 1 per cent. iron and a small amount of tin.

Tensilite is another manganese bronze of variable composition, but the copper is usually about 64 per cent., and, in addition to manganese, aluminium and iron are the chief alloying elements. The strength of this alloy in the cast state is as much as 40 tons per square inch, with an elongation of about 15 per cent. A brass containing about 2 per cent. of manganese is used in the form of extruded shapes for ornamental purposes such as window fittings, because of its dark brown or chocolate colour. This colour is not that of the alloy itself, but of its outer skin only, and is due to manganese oxide formed at the extrusion temperature.

The Effect of Iron

It has long been known that iron increases the strength of 60:40 brass, and of this class of alloy Delta metal is the best known. The term Delta metal is now also applied to bronzes which contain manganese, tin, and aluminium in addition to iron. The copper content is about 55 per cent., iron and manganese together about 4 per cent., and other elements 1 per cent. The alloys are strong and tough, and can be readily worked hot. Durana metal is similar to Delta metal, but is usually richer in copper and contains aluminium. Rubel metal is an alloy in the same class, but generally contains a number of alloying elements as well as iron.

Of the bronzes containing only iron as an extra element, Aich metal, the special features of which are its tenacity and colour, contains about 60 per cent. copper and 2 per cent. iron. Sterro metal is a similar alloy containing more iron, and in the forged condition has a tensile strength of 30 to 35 tons per square inch. This name is also applied to certain 60:40 bronzes containing 1 to 4 per cent. lead. According to Smalley, 1 per cent. iron improves both the strength and shock-resisting properties of 60:40 brass, and such an alloy was found to have 27 tons per square inch tensile strength and 44 per cent. elongation. The use of iron alone in bronzes is very limited compared with its use as an alloying element along with such other metals as nickel, manganese and aluminium.

The effect of aluminium is to increase progressively the strength and yield point, at the same time reducing both the shock-resisting properties and the ductility. In 60:40 brass, Smalley found that the maximum tenacity was reached with 3 per cent. aluminium, and when this figure is exceeded the strength is impaired because of the presence of the gamma constituent. In the cast condition, the alloy containing 3 per cent. aluminium had a tensile strength of 42 tons per square inch, and an elongation of 18.5 per cent. Usually aluminium

as an added element to bronzes is found in association with nickel and iron.

Nickel

High tensile bronzes containing nickel are amongst the most promising of these alloys, and both Guillet and Smalley have contributed to our knowledge of the subject. The addition of nickel in amounts up to 2 per cent. materially improves the ductility of the 60:40 type of alloy without appreciably affecting the strength. On the other hand, the same addition to a brass containing only 50 per cent. copper increases both the strength and the ductility. In these bronzes nickel replaces copper, and therefore the advantages of its addition are most marked when the copper is low, that is, about 50 per cent. If the zinc is maintained at about 45 per cent., the addition of nickel progressively increases the strength without appreciably affecting the elongation until more than about 12 per cent. is added. Alloys containing equal amounts of copper and zinc and 10 per cent. nickel are white in colour and can be hot worked. In the cast condition, the tensile strength is about 30 tons per square inch, which is raised by working to about 45 tons. Alloys of this type are known as nickel bronzes and seem likely to meet with increased use.

Although in many cases the effect of one element on the properties of copper-zinc alloys of various compositions has been studied to some extent, most of these studies are incomplete. The effect of several elements other than nickel, aluminium, iron and manganese, has scarcely been investigated at all. Combinations of two or more elements have also been considered, but here again the field of work is so wide that up to the present only very limited information is available. What has already been done, however, has provided valuable information, and in some instances it has been shown that some of the very complex alloys which have been used in commerce, the compositions of which have been arrived at purely empirically and without knowledge of the effect of the additions of the added elements, have properties which are no better than many of the simpler alloys. While this is no argument against the use of complex compositions for special and high-tensile bronzes, it does indicate that before the full benefits of the addition of several elements together can be obtained it is essential to have accurate information on the effect of them individually and collectively. It is possible that the good effects of one are sometimes actually counteracted by another, or that the advantages of the addition of one element or more could be obtained by the use of similar addition of cheaper metals. Investigations of this kind involve considerable work, and reliable data can only be obtained gradually.

M. C.

International Foundry Trades Exhibition

THE International Foundry Trades Exhibition will be held, June 5-15, at the Royal Agricultural Hall, London, N.1. The stand of the Bureau of Information on Nickel (1a/C) is designed to illustrate the various applications of nickel in ferrous and non-ferrous castings, and the exhibits are arranged in the following sections:—Nickel cast iron, nickel non-ferrous alloys, nickel in heat- and corrosion-resisting alloys and nickel alloy steel. One of the most remarkable recent developments in the use of nickel undoubtedly lies in its application in cast iron. It has been established that small additions of nickel, made under favourable circumstances, have a very beneficial influence on the iron, resulting in greater strength, soundness and density, hardness and wear resistance in the finished casting.

The development of nickel cast iron has been largely based on the remarkable equalisation in structure and hardness which is obtained between thick and thin sections of a casting. This property of nickel iron has very far-reaching results, for in the first place it gives the foundryman an iron possessing a much greater latitude, eliminating waste and defective castings on account of hard spots in machining on the one hand, and on the other hand eliminating trouble with openness and porosity in difficult castings. Success in the application of nickel in cast iron is in great part due to the development of a low melting point shot, "F" shot, which can be added to the iron as it leaves the melting furnace.

Metallurgists will be in attendance at the stand of the Bureau of Information on Nickel to give advice on any subject concerning nickel.

Improved Reflex Furnace

By Robert Saxon, B.Sc.

In a previous article in THE CHEMICAL AGE (see the issue of October 6, 1928, Metallurgical Supplement, p. 27) a reflex furnace is shown which will easily and quickly give a temperature of $1,250^{\circ}\text{C}$. with an ordinary blowpipe, and bring about in less than 15 minutes the reduction of a number of refractory oxides, as well as of the common ones, rendering possible the smelting of metals in the laboratory. Though satisfactory in a way, it is obvious that all or a great percentage of the available heat is not kept to the apparatus, and the arrangements here shown are successful in preventing loss by vertical outpouring. It is a well-known fact that the hotter the mixing gases the greater the heat of combustion. For this reason the upward rushing exhaust is made to heat one or more baffle plates. These baffle plates, being connected with the tubes, conduct their heat to these latter and raise the temperature of both gas and blast.

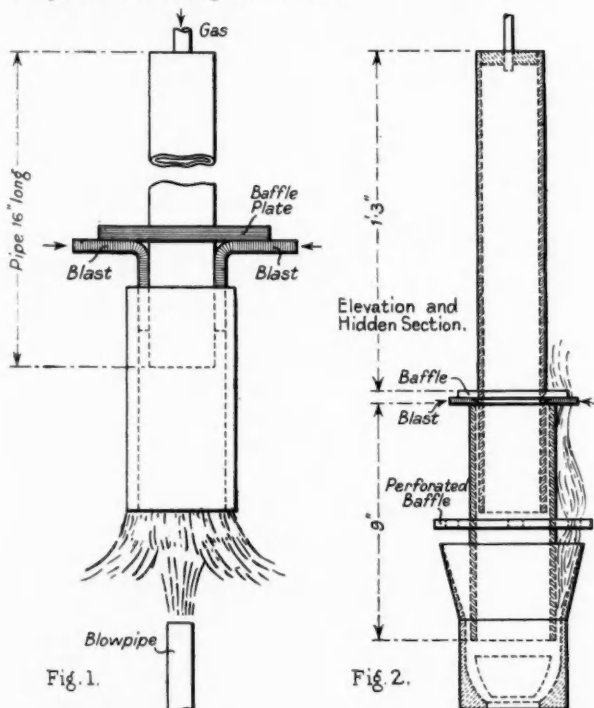


Fig. 1 shows a simple arrangement, the gas coming vertically downward in a pipe heated by the baffle plate shown. The blast of the blowpipe by a side piece comes in as shown, also to be heated by the up-draught. To ensure this up-draught, a fireclay chimney vertical tube encloses the whole up to the blast and baffle plate, where the up-draught finds exit. The blast pipes are two or four in number. They end about one-fifth of the way down the sleeve, the gas pipe about two-fifths. The crucible is supported so as to show a little of its base. The best position, found by experiment, depends on the blast and the quality of the gas. The pipeclay chimney projects a little below this.

To bring about a reverberatory "lashing" by the heat, the blast of the blowpipe, and that under the baffle plate, are alternately reduced and released. This can be done roughly by pinching with pulsating movement the rubber tube supplying the stronger blast, that of the blowpipe or of the by-pass. This pinching of one gives the other a chance to direct the current, and incidentally the heat.

In Fig. 2, we ensure a greater conservation of heat by the employment of two baffle plates, the lower one perforated with four or six holes. These latter may be closed by plugs for experimental purposes, as it is impossible to state at the outset how much heat should hit the lower baffle, and how much should pass along quickly to the upper one. Obviously a stronger blast may be used with this arrangement than with

the one in Fig. 1. As the blast is colder than the gas (top supply), after the top pipe gets heated, this blast must have a chance of acquiring heat rapidly. This is all a matter of arranging the annular space between the sleeve and the pipe. The blast enters here, and in blowing down spreads and drags air along with it. The hot mixture should have a good chance of impinging on the crucible with maximum heat of combustion, and, owing to the heat engendered, does not need much flame length.

The hearth holding the crucible should be furnished with lugs to support the latter, as shown. The hole should be slightly larger than the crucible base, as there is no advantage in giving down-blast heat a chance of rushing past the blowpipe flame, and the latter offers no resistance outside itself. The blowpipe should have as little annular area round the base of the crucible as possible, provided that the flame all enters the hole at the bottom. Indifferent consideration of this will effect enough "cooling" by the upward suction to render the whole no better than that of Fig. 1.

Every part of the apparatus shown in the two figures is circular in section, including the baffle plates. If these are made of copper they may be in laminae. Fig. 1 is an elevation simply with hidden parts (as the blast pipes), shown by broken line. In Fig. 2, a dotted section is shown, giving a section of the whole superimposed upon the elevation. Of course, the top nozzle for the rubber tube, the baffle plates, and the crucible are not in section, as it is unnecessary to cut them, and such cutting would not add to the clearness of the drawing.

Safeguarding Iron and Steel

THAT safeguarding was inevitable for the iron trade was the opinion expressed on Tuesday by Mr. Benjamin Talbot, deputy chairman and managing director of the South Durham Steel and Iron Co. and the Cargo Fleet Iron Co. Mr. Talbot was speaking at a meeting held at Stockton. "I am so convinced," Mr. Talbot said, "that safeguarding is bound to come that we have decided to reopen one of our plate mills here. I anticipate that it will be in operation within the next few weeks. If we obtain safeguarding, which I feel certain we shall, then I feel very confident that the entire works will be put in operation."

Sir W. Joynson-Hicks, the Home Secretary, said at a meeting in St. Pancras, London, on Tuesday, that they wanted to safeguard those trades which were being hit by unfair foreign competition through longer hours or lower wages in other countries, not those that were inefficient. During the last fifteen years the imports of steel and iron had increased to four and a half million tons, or nearly doubled. If this country could only keep two million tons of that steel it would mean that 14 million tons of materials would be required to produce it, and would be carried on the railways, which would mean that more than $1\frac{1}{2}$ million truck loads extra would be carried on the railways every year, thereby creating extra employment on the railways. A man could make 25 tons of steel a year, so that 80,000 extra men would be required in the steel works alone, apart from the employment provided in other directions.

Empire Copper

THE importance of Northern Rhodesia as a source of copper production for the Empire was emphasised on Tuesday by Sir Edmund Davis, when addressing members of the Royal Empire Society. The copper requirements of the Empire Sir Edmund put at 300,000 tons a year, and as the Northern Rhodesian field, he said, was capable of producing far more than that amount, he urged that nothing should be left undone to secure production at the earliest possible date. As an instance of the care which was taken in prospecting, Sir Edmund mentioned that one company, which has a concession covering an area greater than Great Britain, employed sufficient field surveying parties to guarantee the visual observation of every square yard of the land involved. It should always be realised by those controlling Rhodesian industries and railways, he said, that the opening up of the mineral resources of such a country led to increased population and prosperity.

Metallurgical Topics: Monthly Notes and Comments

From Our Own Correspondents

Foundry Conditions: A Comparison.

SIR HUGO HIRST made some interesting remarks when, on May 23, he presided at the banquet of welcome to the American foundrymen who are attending the third International Foundry Conference, which is to be held in London, June 10-13. He emphasised more particularly the extreme difficulty of comparing, with any degree of accuracy, foundry conditions, methods and equipment in this country and abroad, particularly in the United States. On the other side of the Atlantic, he said, the manufacturer can impose his will on the customer. Hence mass production, standardisation and repetition work are carried to an extreme degree of development, with a corresponding reduction of production costs. In Great Britain these conditions are reversed. The will of the customer is imposed on the manufacturer, who has to make an almost infinite variety of castings in comparatively small quantities. This, of course, affects foundry practice from start to finish, and has many implications which militate against what is usually known as "efficiency." It is doubtful whether, in considering British industrial conditions, enough weight is generally given to those controlling factors, which, in regard to metallurgical operations, are perhaps more restrictive of full "mechanisation" than any others that prevail, and more decisive in foundry practice than in any other industry. Sir Hugo did not actually say so, but his remarks might be said to apply with force to the old doctrine of Adam Smith respecting the relation between sub-division of labour and the extent of the market. The extent of the British market is limited, and the demand infinite in its variety. In America it is diffuse, but far more concentrated on special and standardised parts. Hence division of labour, with all its attendant saving in production costs, has inevitably been carried further than it has—or as yet can be—in Great Britain.

X-Ray Work on Hardened Steel

WHAT the microscope has in the past done for scientific research on the structure of metals—and its contribution has been of direct and invaluable help to the development of metallurgical practice—will in the early future be surpassed by the X-ray method of examination. An example of its application to the elucidation of a purely technical problem is afforded by the research on the structure of hardened steel, by X-ray examination, carried out by N. J. Seljakow, G. V. Kurdumof, and N. T. Goodtzow, and translated in two consecutive recent issues of the *Revue de Métallurgie*, by L. Dlougatch. One of the objects in view was to clear up the apparent discrepancy between the views of Westgren and Phragmen, Wever and others, and those of Fink and Campbell. The former regard austenitic steels as a solid solution of carbon in γ -iron, whereas Fink and Campbell, working on a 1.5 per cent. carbon steel, described, for the first time, a tetragonal structure occurring in iron-carbon alloys, and of the centred type. This would conflict with the general view that in martensite the iron is in the α -form, of that the conditions of its formation correspond with a solid solution of carbon in α -iron. In an endeavour to settle the question, the Russian investigators employed three pure crucible steels containing respectively 0.84 per cent., 1.02 per cent. and 1.18 per cent. of carbon. These were first given a softening anneal; then slowly cooled and examined by the X-ray method. Due care had been taken to avoid decarburisation, or of oxidation of the samples. They were subsequently reheated to 1,000° and 1,100° C. and quenched, the same precautions being observed. The structure was examined by the Debye-Scherrer method.

The Tetragonal Lattice

A COMPARISON between the spectrograph of the quenched steels and of the annealed steels showed that the ray markings of the former were always diffuse. Those of austenite were much less diffuse than those emerging from the tetragonal lattice, which was again found, and the nature of which it is sought to explain. It is thought by the investigators that the fact that in quenched steel the transformation of γ -iron

into α -iron is incomplete may be accounted for by the presence of carbon in the centred tetragonal lattice. The intensity of the austenite rays and those from the centred tetragonal lattice are not homogeneous. Possibly crystallites of fairly large dimensions occur, but while this would be a reasonable inference in the case of austenite, it is less easy to understand in the case of martensite. As the result of all the observed facts, the authors conclude that: (1) The existence of a tetragonal cube-centred structure resembling α -iron and occurring in quenched steels has been established; (2) The relation between the parameters of the tetragonal cube-centred lattice is, under similar conditions of hardening, the more pronounced in proportion as the percentage of carbon increases, and when the latter remains constant, in proportion to the temperature at quenching; (3) The existence of a face-centred (austenite) lattice in hardened steel has been established; (4) The cube-centred tetragonal structure found in a hardened carbon steel is to be regarded as a *sui generis* kind of solution of carbon in α -iron; and, finally (5), The mechanism of the hardening of steel may be regarded as a process tending to the conservation of a structural state intermediate between the gamma and alpha structures. In the light of the now defunct β -iron theory, these findings are suggestive.

The Non-Ferrous Metals Research Association

THE value of the work of the British Non-Ferrous Metals Research Association to industry is perhaps best known and appreciated by the subscribing members, who have prior access to its reports. Those who are not brought into this close touch with its activities have, nevertheless, the means of estimating the service of the Association to technology when papers like that by Mr. Hudson are liberated for reading before different societies and institutes. The Third (experimental) Report to the Atmospheric Corrosion Committee, communicated to the Faraday Society at its meeting on May 23 last, carries a stage further the interesting results obtained by Mr. Hudson and his staff. The wide range of metals tested, and the valuable indications recorded, cover too much ground for adequate discussion in these columns, or for more than an appreciative comment on the work. It is urgently necessary, however, that a wide public should be informed of, and learn to appreciate, what is being done under the auspices of the Association, seeing that, unless greater support is forthcoming, the usefulness of the Association may be seriously impaired in the future through lack of funds. A very serious situation was revealed at the annual meeting, held early last month, as the Government "fifty-fifty" contribution is in danger of being withheld unless the Association succeeds in obtaining a minimum income from subscriptions in excess of that which it already obtains. The need for support is thus urgent. With it the work can go on and be extended. Without it, a state of paralysis might ensue, and the industry find itself deprived of a potent instrument for the advancement of applied science, which the industrialists of other nations appear to appreciate more than British industrialists as a whole seem to do. There are 4,500 firms engaged in non-ferrous metallurgy in this country. Hitherto only 145 of these have become subscribing members of the Association.

Committee on Supply of Scrap

THE President of the Board of Trade has appointed the following committee to inquire into the position as to the supply of scrap for steel-making in the United Kingdom: Mr. R. Roy Wilson (chairman), Sir Henry Fowler and Sir Alfred Herbert. Mr. C. K. Hobson, Board of Trade, will be secretary. Mr. Roy Wilson has been member of Parliament for the Lichfield Division since 1924, but is not seeking re-election. Sir Henry Fowler is chief mechanical engineer of the London, Midland and Scottish Railway, and past president of the Institution of Mechanical Engineers, and during the war held a number of posts in the Ministry of Munitions. Sir Alfred Herbert is chairman and governing director of Alfred Herbert, Ltd., of Coventry, and president of the

Machine Tool Trades' Association; during the war he was Controller of Machine Tools in the Ministry of Munitions.

Cadmium

VERY appropriately, for the subject is just now one of unusually great interest, the Imperial Institute has published, in its series dealing with "The Mineral Industry of the British Empire and Foreign Countries," a pamphlet on *Cadmium* (H.M. Stationery Office, pp. 23, 9d.). The subject is treated under the following headings:—General, extraction, alloys, other uses, cadmium pigments, other compounds of cadmium and their uses, electrodeposition of cadmium, world's production, sources in the British Empire and foreign countries, and references to technical literature.

World's Production

UP to 1922, nearly the whole of the world's production of cadmium came from the United States and Germany (Silesia), although a little was made at electrolytic zinc plants in England. In 1922, the Anaconda Copper Mining Co. started its new electrolytic plant at Great Falls, Montana, and began to produce cadmium at the rate of 500 lb. daily. In the same year the Electrolytic Zinc Co. of Australasia, Ltd., commenced cadmium production at Risdon, Tasmania, which in the following year amounted to over 100 tons, the result being that the price of the metal in the United States fell from \$1.10 to 80 cents per lb. In 1924, the latter country produced about 66 tons of cadmium, but in 1925 and 1926 there was a rapid increase, culminating in 480 tons in 1927. In 1926 the price of the metal fell to 60 cents per lb. Early in 1928 the Consolidated Mining and Smelting Co. of Canada, Ltd., began producing at Trail, British Columbia.

A considerable increase in the world's output of cadmium may be expected from new electrolytic zinc plants, which have either started production or are in course of construction, notably at Trail (increase of plant), Anaconda, Kellogg (Idaho), two plants in Polish Silesia and one at Odda, Norway.

Canadian Production

CADMIUM was produced in Canada for the first time in 1928, the output amounting to 491,894 pounds, valued at \$341,274. All the cadmium produced in Canada is exported, most of it to Europe and some to the Orient. Cadmium is not mined as an ore, but is a by-product obtained in the production of zinc, and, in some cases, of lead, being associated in small amounts with these metals in their ores. The recovery plant of the Consolidated Mining and Smelting Co. at Trail, British Columbia, which started producing early in 1928, has been treating accumulated cadmium residues from its zinc plant, and is producing refined cadmium. In other countries, cadmium is marketed not only as metallic cadmium but also as cadmium sulphide. In the metallic state cadmium rarely contains 0.5 per cent. of impurities.

The Hudson Bay Smelting and Refining Co. plans to erect a zinc refinery at the Flin Flon mine in northern Manitoba. It is also reported that two new zinc refineries may be erected in eastern Canada—one by the Consolidated Mining and Smelting Co., in association with Ventures, Ltd., near Sudbury, Ontario, and the other by Noranda Mines, Ltd., in association with the British Metals Corporation and the Nichols Copper Co. It is possible that these plants may eventually produce cadmium residues, and may erect the necessary recovery plants if conditions justify such a course. During the past year (states the Canadian Department of Mines) the market for cadmium has been buoyant, owing to the fact that the application of this metal for plating purposes has developed rapidly and increased the consumption beyond expectations. Cadmium is also being employed by colour makers to a greater extent because of the increased use of "cadmopone." The world's production in 1928 was estimated at 1,100 tons.

Naval Use of Aluminium Paint

THE United States Department of the Navy Bureau of Construction and Repair General Information Bulletin No. 1-27, outlined results obtained in tests of aluminium paint, and indicated that it would probably be much more widely used in naval vessels because of its light weight and excellent properties. The first important extension of the use of aluminium paint was the authorisation, in May, 1927, of its use as a

priming coat, in place of red lead, on exterior and interior metal surfaces of the U.S. Navy vessels *Salt Lake City* and *Pensacola*. As aluminium paint has a tendency to soften and blister when continuously submerged or subjected to protracted periods of submergences in fresh or salt water, its use was not authorised on the outer surfaces of the hull below the second deck level or on interior surfaces subject to immersion, as in water tanks and bilges.

The varnish vehicle of aluminium paint will not withstand exposure to petroleum products, and accordingly aluminium paint was not authorised for use in fuel-oil tanks. Neither was it authorised for use on decks to be covered with wood planking. These surfaces cannot be kept under observation, and it was not considered desirable to use an experimental coating. In September, 1927, the use of aluminium paint on the *Salt Lake City* and *Pensacola* was further extended to include applications as a finishing coat for a large number of spaces, such as magazines and storerooms. Reports from the above vessels indicated that aluminium paint, under the conditions of ship constructions, was giving as satisfactory results as red lead, and that it possessed advantages over red lead, such as saving in weight, improved interior lighting of the ship, more agreeable working conditions, greater ease of inspection, and better appearance. Accordingly, the use of aluminium paint has recently been authorised for United States light cruisers 26 to 31, inclusive, with the same limitations as in the case of the *Salt Lake City* and *Pensacola*.

New Canadian Copper Refinery

ACCORDING to an announcement by the Prime Minister of Ontario in the Provincial Legislature, arrangements have been completed for the erection of a copper refinery at Copper Cliff, in the Sudbury district of Ontario, by interests including the International Nickel Co., the Consolidated Mining and Smelting Co. of Canada, Ltd., Cherritt Gordon Mines, and Ventures, Ltd. The plant, which will cost at least \$4,000,000, will have an initial capacity of 120,000 tons per annum; will require the employment of 600 men with a payroll of approximately \$730,000; and have an annual expenditure for supplies and materials estimated at \$300,000. The hydro-electric power requirements will be about 6,000 horse-power. The construction of the new refinery will commence immediately, and it will be completed and ready for operation in about 18 months. The facilities of this new company will be available as a customs refinery, and for this reason, as well as to provide for the increased production of copper incident to the further development of the Froid mine, it is expected that the initial unit will be duplicated within a short time.

U.S. Production of Aluminium, 1928

THE value of new aluminium produced in the United States during 1928 was \$47,899,000, an increase of 22 per cent. as compared with 1927. The principal producing plant was that at Massena, New York, where approximately 45 per cent. of the metal made in the United States was recovered. Other works are at Niagara Falls, New York; Alcoa, Tennessee; and Badin (Whitney), North Carolina. The domestic price of new aluminium ingot, 99 per cent. pure, was 24.3 cents a pound during the entire year 1928. Prices of outside metal 98-99 per cent. pure held throughout the year at 23.9 cents a pound.

The record production of automobiles in 1928 and the wider adoption of aluminium pistons and connecting rods in the manufacture thereof combined to greatly increase the consumption of aluminium by the United States automotive industry in 1928. Aluminium furniture has come into a position of prominence rapidly, and many railroads have adopted aluminium chairs as standard equipment in their dining cars, and installations have also been made in offices and libraries. The use of aluminium in experimental work in railroad car construction and the equally prominent field of commercial truck body manufacture continued during the year. The use of aluminium bronze powder as a paint pigment, and of aluminium for screw machine parts, bottle caps, foil, and collapsible tubes, showed a normal increase in consumption during 1928, and in the aircraft industry the rate of consumption of aluminium strong alloys is said to have trebled within the year.

Trade, Commerce, Finance : The Month in Review

From Our Market Correspondent

MAY has been another broken month, owing to the Whitsuntide holidays. A stoppage of one or two days was general throughout the steel works, and in some districts, particularly Lancashire, little or no trade was done during Whit-week. Another disturbing influence is the general election, which will have been held by the time this report appears. That is bound to cause a further interference with trade in the closing days of the month. However, trade has been well maintained during the month in comparison with previous periods, and most of the mills are fairly well placed for specifications, plates, as usual, being the weakest line.

Advance in Steel Prices

The most important feature of the month has been the advance in the official prices of steel controlled by the Steel Associations, including sections, large bars and plates. At the joint meeting held on May 16 it was decided to advance the price of all home orders by 5s. per ton, the rebate to remain as before. This 5s. will help the steel makers to meet the increased cost of production occasioned by the higher prices of scrap and coke, but it will not fully cover the increased cost. At all events, it is a move in the right direction, and has been long overdue.

For a considerable time past the selling prices of steel have been barely sufficient to give any return even to the most modern and best equipped plants, while to many works they have been definitely on the losing side. There has been no real advance in prices since 1927. The 5s. which was put on last year was accompanied by an increase of a like amount in the rebate, so that the net price to the steel makers remained the same. The works cannot continue indefinitely to lose money, and as there is no likelihood of a decrease in costs with the volume of trade at present available, the only salvation is in higher selling prices. There is no commodity which has approached more nearly to the pre-war selling prices than steel, and the steel makers cannot be blamed for remedying this unfair position.

Present Position and Future Prospects

This movement in price is no surprise to the markets generally; indeed, consumers expected it long ago, and they had covered themselves well ahead before the advance was notified, so that for some time to come the steel makers will not get the full benefit of it. The shipbuilders have raised a protest against it. They say that the rebate scheme has enabled them to use British steel plates and sections in place of Continental ones, and that this advance will seriously affect them. The complaint is rather overdone, as most of them have covered their requirements for some time ahead at the old prices, and the advance is not large enough to hamper their trade.

If a halt could be called to the rise in costs the steel makers would have cause to be more hopeful in their outlook. In a few months' time, the full effect of the higher selling price will be realised, and in the second half of the year the full benefit from the rating relief will be in operation. Unfortunately, however, it is not possible to say that the rise in price of raw materials is ended. There seemed to be a rather easier tendency in scrap a few weeks ago, but the demand has again strengthened and prices are moving upwards. It is noteworthy that a committee has been appointed by the Board of Trade to inquire into the position as to the supply of scrap for steel making in the United Kingdom. It is doubtful whether any real good will come of it, unless it forces home the necessity of prohibiting the export of scrap so that supplies shall be available at reasonable prices for the steel makers in this country.

Coke

Coke is still very firm, and for new contracts the price is inclined to harden. It is just possible that the position in regard to coke may change in the near future. For some time the demand has been greater than the supply, and this has been reflected in the selling prices. The short supply has

been due to the shortage of coking slack, following on the reduction of the output of coal under the coal control scheme.

The demand for coke for export has continued good, and the home users have had to suffer from the shortage. There are now indications that the coal control scheme is not working at all smoothly, and it would not be surprising if it were shortly to cease to operate. It is well known that several of the larger collieries are dissatisfied with the results, and the dissatisfaction is spreading. With the collieries free to produce as much coal as they wished there would be larger supplies of slack available, and the increased output of coke would eventually lead to lower prices.

United Steel Companies

The acquisition of the United Steel Companies by the Austin Friars Trust is now practically an accomplished fact, and the further developments of this scheme of rationalisation will be awaited with interest. There have been some outspoken criticisms, which may not be far off the mark.

No plan of rationalisation will be really effective unless it can regulate the productive capacity so as to be in economical relation to the demand, and that involves a centralised control over the whole of the steel industry. We are a long way from that state. Something of the kind is being tried by the associated steel makers in regard to the export trade. There is a central committee which has power to secure orders for export in competition with other countries, and allot the orders received to the steel works. That scheme, however, is limited strictly to the export trade, and there is no suggestion of any such control applying it to the home trade.

Pig Iron

The pig iron trade has remained very steady. The holidays caused some falling off in the business done, but prices remain very firm, and it is fully expected that business will be resumed on a good level as soon as the election is over. The position varies in the different districts. In the Cleveland area the demand is still in excess of the present supply, and there is every probability of more furnaces being blown in. There are practically no stocks at makers' works. In the Midlands and in Lancashire business is rather quieter, as most consumers are working off contracts made earlier, and there is not much fresh tonnage being booked. Prices remain unchanged, but there is no tendency towards reductions.

The hematite trade continues good, and in this also the demand has overtaken the supply, the possibility being that the output will be increased in the near future. In the steel trade, billets and small bars remain the most satisfactory features. The Billet Association has resumed its activities, and is controlling the prices of both acid and basic qualities. Advances were made in the prices of basic billets some weeks ago, and more recently acid steel has been put up 10s. per ton. Although there has been a slight weakening in the price of Continental billets, the demand for supplies from the home works is still good, and most of the makers have good order books, particularly for the basic steel.

Bars and Plates

The small bar mills are fully occupied, and some of the makers are unable to promise delivery earlier than two or three months. A good deal of the trade is for the better qualities, and this is not affected by foreign competition, as users prefer to pay the higher price for uniform and reliable qualities. The re-rollers are not quite so well placed, as they are having to face some low quotations from the Continent. There is no change in the plate trade. The mills which are working on ship and tank plates are occupied to only about 40 per cent. of their capacity, and this position seems likely to continue indefinitely. Boiler plates have not shared in the advance in prices, as there is no effective control and competition is very keen.

The output of pig iron during April was 611,300 tons, compared with 590,500 tons in March, there being seven more furnaces in blast. The output of steel was 808,600 tons compared with 859,900 tons in March.

Some Inventions of the Month

By Our Patents Correspondent

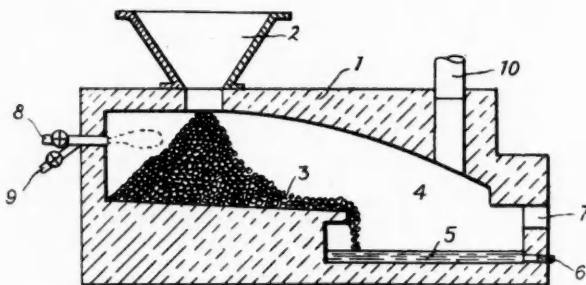
Abstracts of other Patents of metallurgical interest will be found in our Patent Literature, published weekly in THE CHEMICAL AGE.

Chromium Plating

THE electrolyte in a chromium plating bath is a solution of a chromate or bichromate of an alkali or alkaline earth metal and an acid which is preferably hydrochloric or oxalic acid or a mixture of both. In an example in which sodium bichromate, hydrochloric acid, and oxalic acid are used, the reactions in the bath are stated to result in the production of sodium chlorochromate, chromium chromate, and sodium chloride, together with some excess of hydrochloric acid. The free hydrochloric acid may be replaced by acetic or phosphoric acid. The anodes may be of graphite, magnetite, or chromium. See Patent Application 308,771, bearing the International Convention date March 29, 1928, by Ternstedt Manufacturing Co. of Detroit, Michigan, U.S.A.

Copper

A PROCESS for melting and refining crude or partially refined copper, such as that of anodes or cathodes obtained in the electrolytic recovery of the metal, is described in Specification 309,848, dated January 16, 1928, by H. H. Alexander, of Westfield, New Jersey, U.S.A. The charge is progressively melted, with subjection of the molten metal to a purifying action, by causing to impinge upon it hot combustion gases the nature and composition of which are regulated in accordance, with the impurities present. In the reverberatory



309,848

furnace arrangement shown, the charge, falling from a hopper 2 on to a sloping hearth 3, is melted and refined by hot gases from one or more burners supplied with air and fuel by pipes 8 and 9, respectively, and the molten metal is withdrawn at 6 from a well 5, the slag being removed at 7, and the waste gases passing to the stack 10. Test portions of the molten metal are preferably taken periodically and analysed in order to determine the relative proportions of air and fuel to be supplied to the burners.

Iron

In smelting oxide iron ores a mixture of the ore with carbonaceous fuel and a flux is first heated indirectly in a reducing zone to a temperature sufficiently high to initiate reduction, but not so high as to cause sintering or agglomeration, and the charge is then passed to a smelting zone heated directly by the combustion of the fuel, the combustion gases being utilised for the indirect heating of the reducing zone. The apparatus, which is described and illustrated in detail, comprises a reducing chamber superposed on a blast furnace and traversed by tubes conveying hot air to the bustle pipe and tuyeres. Blast furnace gas escaping from ports near the top of the furnace is burnt with a portion of this air to heat the reducing chamber. See Patent Application 306,949, bearing the International Convention date February 28, 1928, by the Trent Process Corporation, of New York.

Reduction of Ores

CERTAIN ores, particularly of iron, cannot be treated economically in the ordinary way for the production of metals or alloys on account of their finely divided state or of their content of highly refractory material. Such ores, *e.g.*, titaniferous iron sands, are (according to Specification 309,458, dated December 28, 1927, by W. A. Loke, of London) reduced by

repeatedly showering them in a dried and pulverised or finely-divided condition through a hot reducing gas, *e.g.*, producer gas, while descending by gravity through a rotary kiln from which the reduced product is showered under non-oxidising conditions through the arc of an electric furnace in which the final melting and refining are effected. Preferably, a series of such electric furnaces is provided and each is charged in succession from the kiln, thus enabling the process to be carried on continuously. The construction and arrangement of the kiln, the furnaces, and the accessory apparatus is described and illustrated in detail.

Treatment of Iron Pyrites

PROCESSES for the recovery of zinc and copper values from residues obtained in the treatment of iron pyrites are described in Specifications 309,268-9, dated February 10, 1928, by S. I. Levy and G. W. Gray, of London, the processes being intended mainly for use in connection with that described in Specification 307,188 for obtaining sulphur from the pyrites by treatment which includes heating in absence of air and thereafter extracting with hydrochloric acid. The resulting residue is rich in copper, while the solution contains about 90 per cent. of the iron as ferrous chloride, part of the zinc, and all the lead. According to Specification 309,268, this solution, after removal of the lead by electrolysis, is treated with gaseous hydrochloric acid and caused to react while hot with materials containing iron and zinc until the liquor is nearly saturated with ferrous chloride. It is then filtered while hot, and the filtrate cooled to deposit ferrous chloride crystals, which are separated, the cycle being repeated until a solution sufficiently rich in zinc is obtained. According to Specification 309,269, the copper-rich residue is treated by either of the following methods: (1) The residue is exposed to the air at 60-100° C. and thereafter extracted with hydrochloric acid, which removes the whole of the zinc and most of the iron. (2) The residue is roasted at a temperature not exceeding 600° C. to convert the iron into ferric oxide and the copper and zinc mainly into sulphates, and thereafter extracted with water or dilute acid. The copper and zinc are separated from the solution electrolytically or otherwise in known manner. The copper and zinc remaining in the residue may be brought into solution by roasting with ferrous chloride and again extracting with water or dilute acid.

Zinc

A PROCESS for roasting zinc sulphide ores or concentrates to produce a porous material suitable for subsequent distillation for recovery of the zinc is described in Specification 306,569, dated October 24, 1927, by S. Robson, of Avonmouth, Gloucestershire. A coarse granular or nodular material is mixed with the green ore or concentrate in proportion sufficient to ensure such porosity in the charge that air may be readily drawn through it. The charge is then subjected to blast-roasting with substantial exclusion of air other than that drawn through the charge. There is thus obtained a sintered or nodulised product and a gas sufficiently rich in sulphur to enable it to be used without further treatment for the manufacture of sulphuric acid. The granular or nodular material may be a crushed sinter or nodulised product from a previous blast-roasting operation.

Tin

IN a chlorination process for the extraction of tin, described in Specification 309,307, dated April 5, 1927, by E. A. Ashcroft, of Ashburton, Devon, a mixture of the tin-bearing ores or materials with ammonium chloride is heated gently and uniformly to a temperature between 200° and 400° C., and stannous chloride is extracted from the product by volatilisation and/or lixiviation. Cassiterite ores are subjected to a preliminary reduction, *e.g.*, as described in Specification 297,784 (see THE CHEMICAL AGE, Vol. XIX, p. 39 [Metallurgical Section]), or are reduced by nascent hydrogen evolved during the chlorination of other constituents of the charge, or by iron added to the charge for this purpose. When all the ammonia produced in the chlorination has been evolved the temperature may be raised to about 600° C. to enable the ferrous chloride and iron, if any is present, to react with any remaining tin compounds to produce stannous chloride. The ammonia is utilised with or without carbonic acid or sulphur compounds to precipitate the tin from a solution of the stannous chloride as oxide, hydroxide, carbonate, or sulphide, with regeneration of ammonium chloride.

Current Articles Worth Noting

We give below a brief index to current articles in the technical Press dealing with metallurgical subjects.

ALLOYS.—The system nickel-iron. G. J. Sizoo and C. Zwicker. *Zeitschrift Metallkunde*, April, pp. 125-126 (in German). A simple rapid method for the production of single crystals (in wire form) of nickel and nickel-iron is indicated. By means of these it is possible to follow the electrical properties of nickel-iron alloys in relation to the composition in pure test pieces. The specific electrical conductivities and the temperature coefficients of resistance of a series of alloys have been measured.

ALLOY STEELS.—An investigation of the physical properties of certain chromium-aluminium steels. F. B. Lounsberry and W. R. Breeler. *Trans. Amer. Soc. Steel Treating*, May, pp. 733-766. An investigation of the physical properties of steels containing 2-6 per cent. of aluminium and 7-13 per cent. of chromium, with silicon and carbon varying up to 1 per cent. maximum. Data are included on the effect of additions of nickel, cobalt, molybdenum, vanadium, manganese, tungsten and copper. Aluminium effectively stabilises the alpha iron phase, and when in combination with chromium, greatly increased the resistance of the metal to oxidation at elevated temperatures.

High chromium steels. O. K. Parmiter. *Trans. Amer. Soc. Steel Treating*, May, pp. 796-816.

ANALYSIS.—The rapid determination of the tin content of tin-plate and tin-plate residues. J. Haage. *Chemiker-Zeitung*, April 10, p. 287 (in German).

Experimental contributions to quantitative emission spectral analysis. II.—Quantitative spectro-analytic determination of zinc in solution and of molybdenum in steels. H. Thumewald. *Zeitschrift analytische Chem.*, Vol. 76, Parts 9-10, pp. 335-347 (in German).

The determination of sulphur in galena and metallic lead. H. Leysaht. *Zeitschrift analytische Chem.*, Vol. 77, parts 5 and 6, pp. 209-213 (in German).

The determination of silica in steel and iron. R. Wasmuht. *Zeitschrift angewandte Chem.*, May 18, pp. 526-527 (in German).

A rapid method for dissolving high chromium steels for the determination of sulphur. B. S. Evans. *Analyst*, May, pp. 286-287.

CORROSION.—The prevention of boiler corrosion by the addition of alkali. A. Splitgerber. *Chemische Fabrik*, May 22, pp. 253-256 (in German).

Observations on the corrosion of iron. J. F. G. Hicks. *Journal Phys. Chem.*, May, pp. 780-790. The primary cause of the corrosion of iron is the actual solution of the iron in water, which takes place before any other chemical action starts. A film of liquid water adhering to the metallic surface undergoing corrosion is necessary for the occurrence of this dissolving process.

ELECTRODEPOSITION.—The theory of the separation of chromium from aqueous solutions of chromic acid. III.—E. Müller and J. Stcherbakow. *Zeitschrift Elektrochem.*, May, pp. 222-234. (in German).

The separation of chromium from aqueous solutions of chromic acid. J. Roudnick. *Zeitschrift Elektrochem.*, May, pp. 249-254 (in German).

Automatic plating machinery. E. M. Baker. *Ind. Eng. Chem.*, May 1, pp. 400-404.

ELECTROMETALLURGY.—The electrolytic recovery of metals: general bases and points of view for the successful execution of the method. G. Eger. *Zeitschrift angewandte Chem.*, May 18, pp. 518-522 (in German).

GENERAL.—The action of potassium ferrocyanide on silver and on some difficultly soluble silver compounds. E. Bentel and A. Kutzligng. *Monatshefte für Chem.*, Vol. 51, Parts 4-5, pp. 369-380 (in German). Potassium ferrocyanide solutions, on boiling in a stream of air, dissolve finely divided silver, and also silver chloride, bromide, cyanide, ferrocyanide, oxide, carbonate, and chromate.

The effect of sulphur dioxide on bronze and copper. P. Röntgen and G. Schwietzke. *Zeitschrift Metallkunde*, April, pp. 117-120 (in German). The effect of sulphur dioxide as the cause of gas porosity; comparative experiments on bronze and copper.

The boiling points of magnesium, calcium, strontium,

barium and lithium. H. Hartmann and R. Schneider. *Zeitschrift anorganische Chem.*, Vol. 180, Part 3, pp. 275-283 (in German).

Welding in the chemical and process industries. W. Spraragen. *Ind. Eng. Chem.*, May 1, pp. 425-431.

Metallic materials for chemical engineering equipment. E. P. Partridge. *Ind. Eng. Chem.*, May 1, pp. 471-476.

IRON.—Iron manufacture and heat generation. H. Louis. *Nature*, May 18, pp. 762-765.

PLANT.—Progress made in the use of electric furnaces for heat treating. A. N. Otis. *Trans. Amer. Soc. Steel Treating*, May, pp. 767-795.

STEEL.—Surface hardening special steels with ammonia gas. R. H. Hobrock. *Trans. Amer. Soc. Steel Treating*, April, pp. 543-568. When special steels are nitrided with ammonia gas under pressure, the surface hardness decreases with increase in pressure, but at the same time the depth of case greatly increases.

Deoxidation of steel with silicon. C. H. Herty, Jr., and G. R. Fitterer. *Trans. Amer. Soc. Steel Treating*, April, pp. 569-588. An outline of the function of silicon in the open-hearth process, and the mechanism of de-oxidation of steel with silicon.

The application of science to the steel industry. III.—W. H. Hatfield. *Trans. Amer. Soc. Steel Treating*, May, pp. 817-836. Deals with the uses and effects of heating operations.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette, &c.

Company Winding Up Voluntarily

MADUBI TIN CO., LTD.—At an extraordinary general meeting held at 2, Broad Street Place, London, E.C.2, on May 9, the following extraordinary resolution was duly passed:—"That it has been proved to the satisfaction of this meeting that the company cannot, by reason of its liabilities, continue its business, and that it is advisable to wind up the same, and accordingly that the company be wound up voluntarily, and that Mr. A. Garner Stevens, F.C.I.S., of 6, Broad Street Place, London, E.C.2, be and is hereby appointed the liquidator for the purposes of such winding up."

Mortgages and Charges

[NOTE.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described therein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges. The following Mortgages and Charges have been so registered. In each case, the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.]

ASHBURNHAM TINPLATE CO., LTD., Burry Port.—Reg. April 29, debenture, to bank; general charge (ranking next after 100 1st debentures of £100 each). *£10,000. March 12, 1929.

BIRTLEY IRON CO., LTD.—Reg. April 19, £10,000 further charge (supplemental to mortgage and debenture dated July 19, 1928), to D. M. Muir, 44, Grey Street, Newcastle-on-Tyne, and another; charged as in principal deeds. *£20,000. December 31, 1928.

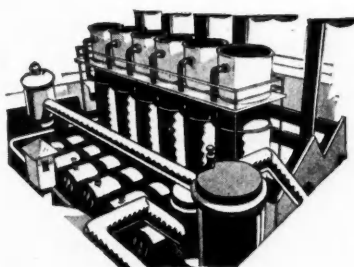
GALLOIS LEAD AND ZINC MINES, LTD., London, E.—Reg. April 16, series of £20,000 debentures, present issue £7,600; general charge, excluding plant, etc., where the purchase price is not fully paid.

METALLURGICAL PROCESSES, LTD., London, E.C.—Reg. April 19, debentures securing all moneys due or to become due to the holders, Anglo-Oriental and General Investment Trust, Ltd., 31/3, Bishopsgate, E.C.; general charge. *Nil. December 31, 1928.

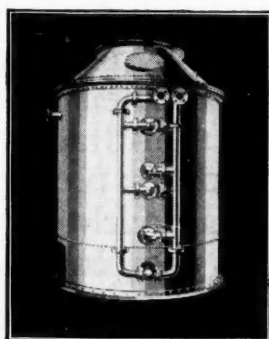
TEJA MALAYA TIN DREDGING CO., LTD., London, E.C.—Reg. May 7, two charges and an assignment as collateral securities to trust deed dated December 21, 1928, securing £100,000 debenture stock and premium of 5 per cent.; charged on properties in District of Kinta Federated Malay State of Perak, etc. *Nil. July 9, 1928.

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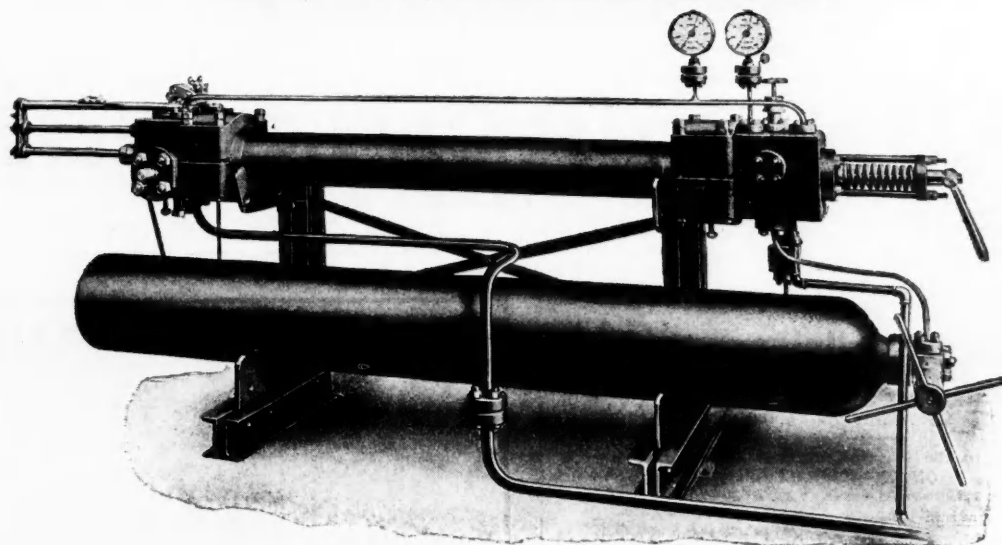
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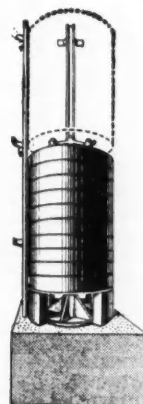
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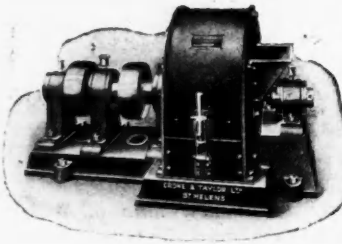
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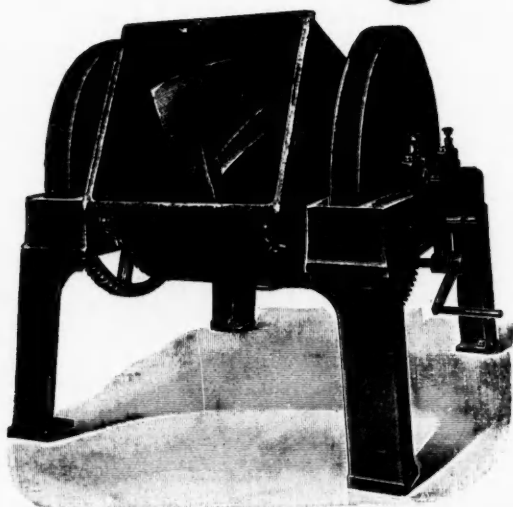
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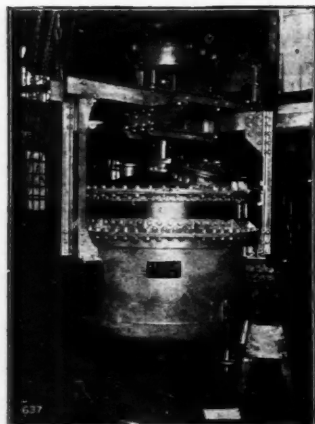
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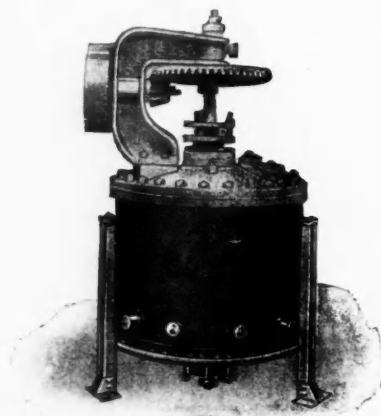
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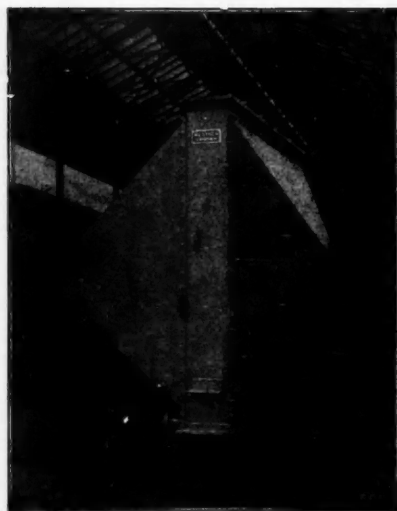
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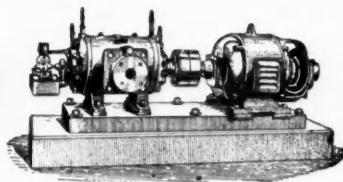
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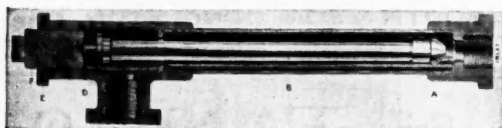
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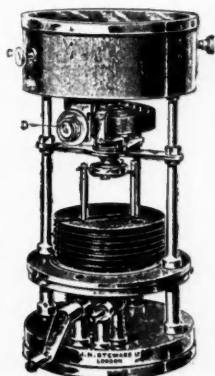


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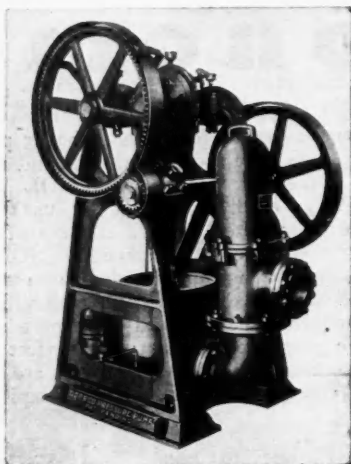


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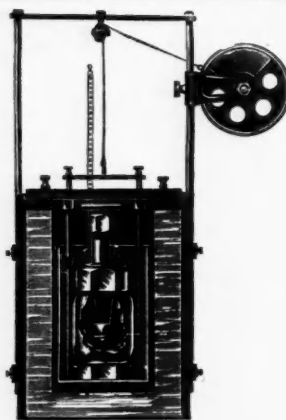
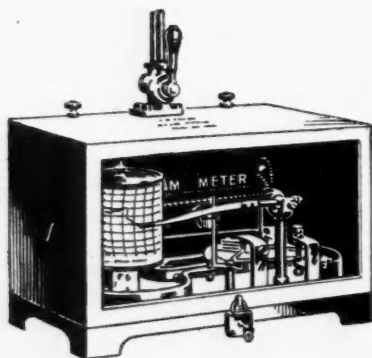
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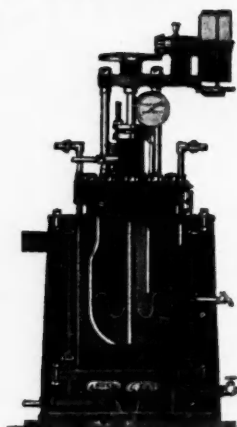


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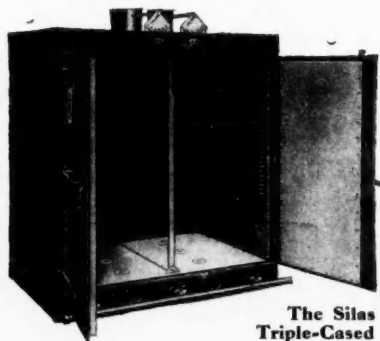
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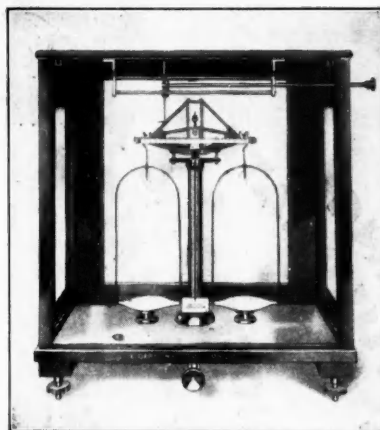
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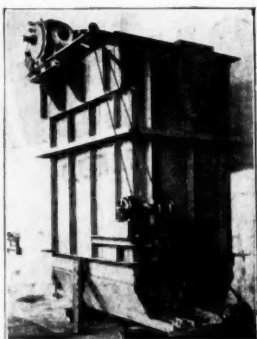
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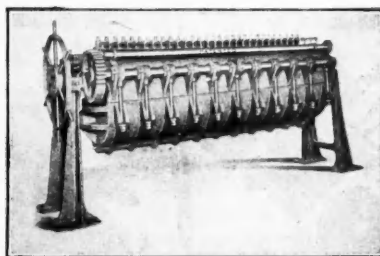


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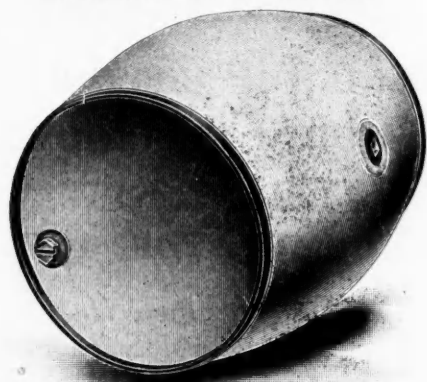


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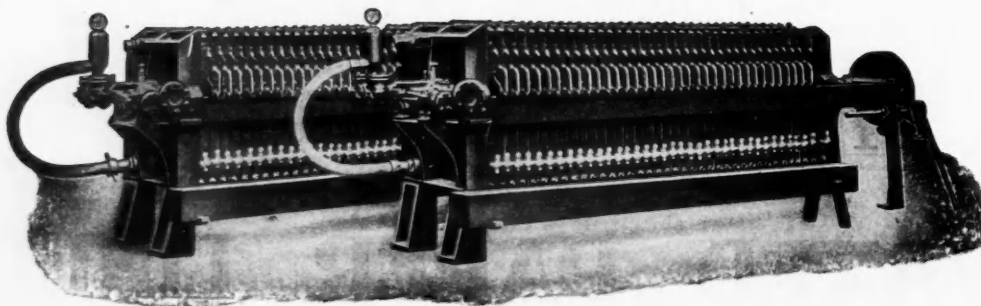
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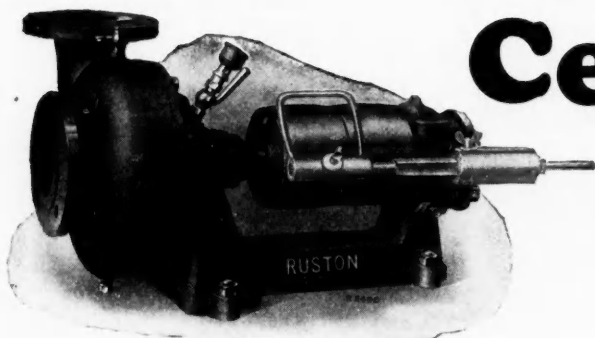
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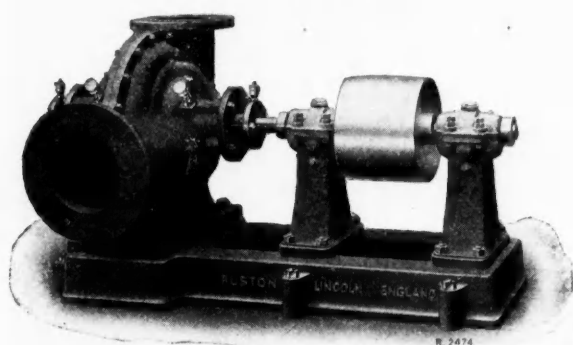
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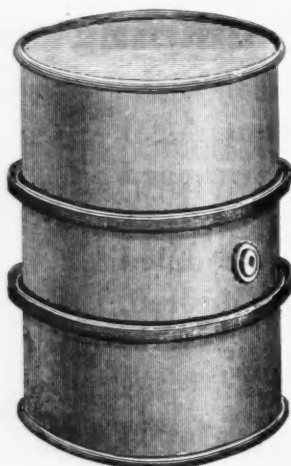
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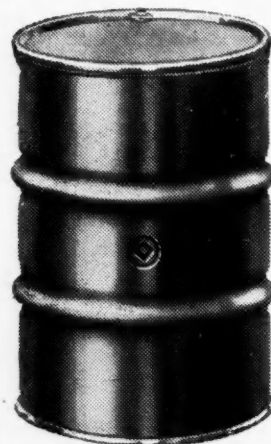
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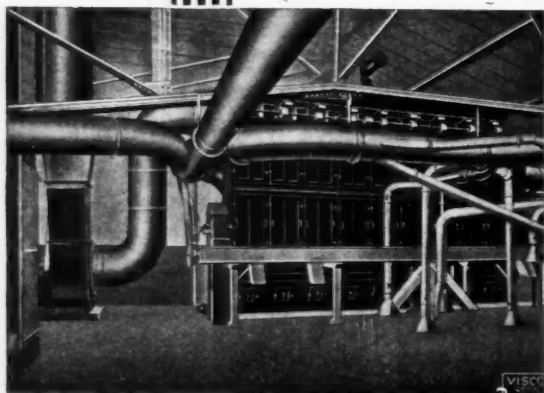


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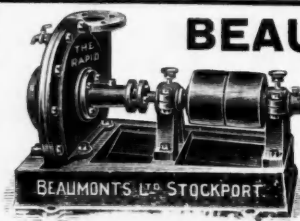
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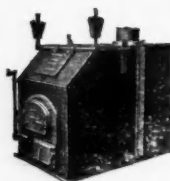
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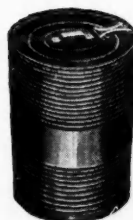
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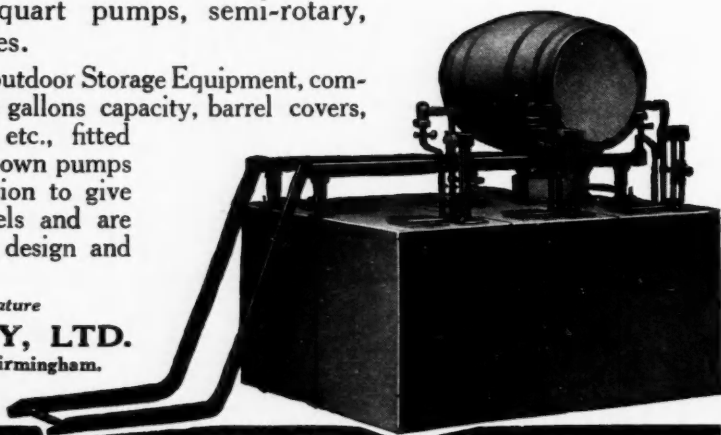
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